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DISCOVERY OF SHORT TIME-SCALE OSCILLATIONS IN HD 74292

The small amplitude variability of HD 74292 was discovered in December 1988 in the course of the work on the Catalogue of WBVR Magnitudes of the Northern Sky Bright Stars (Kornilov et al., 1991). The star has not yet been mentioned as variable in any catalogues and lists of variable stars. Co-ordinates of the star are RA=$8^h44^m14\overset{s}{.}89$, D=+32°03'45''.1 (2000.0), spectrum A2, mean magnitudes and colours are V=$7\overset{m}{.}032$, B−V=$0\overset{m}{.}233$, W−B=$0\overset{m}{.}030$, V−R=$0\overset{m}{.}211$.

The photometric observations were carried out at Tien-Shan High-Altitude Observatory of Sternberg State Astronomical Institute with 48-cm reflector. Four-channel WBVR photometer constructed by V. G. Kornilov and A. V. Krylov and single channel UBV photometer constructed by the author of this paper were used. The total of nine sets of obtervations were obtained on the following Julian Dates:

Set No.	J.D. 24...
1	47509.3008–.3843
2	47622.1753–.3027
3	47623.1284–.2812
4	48255.2734–.5098
5	48278.3701–.4854
6	48291.2607–.4219
7	49028.1445–.4611
8	49040.1016–.4468
9	49043.0877–.2814

HD 75332 (Sp.: F7Vn, V=$6\overset{m}{.}228$, B−V=$0\overset{m}{.}526$, W−B=$-0\overset{m}{.}127$, V−R=$0\overset{m}{.}437$) was used as a comparison star. The stability of this star is undoubted because it has been checked many times during the photometric sky survey (Kornilov et al., 1991), the r.m.s. error of a measurement is of $0\overset{m}{.}002$ in V band. HD 74057 (Sp.:F8, V=$7\overset{m}{.}201$, B−V=$0\overset{m}{.}585$, W−B=$-0\overset{m}{.}099$, V−R=$0\overset{m}{.}486$) was a control star.

The light curves of HD 74292 in V band obtained during the last four sets of observations (Nos. 6−9) are shown in Figure 1. The deviations ΔV from the mean magnitude are plotted against Julian Date. These curves demonstrate rapid oscillations with maximum amplitude of $0\overset{m}{.}05$ in V.

A preliminary periodogram analysis was carried out using Deeming's (1975) and PDM methods in the period range from $0\overset{d}{.}025$ to $0\overset{d}{.}10$. The whole data set does not give definite result. Sets 1−3 confirm variability but are not sufficient for independent period search. Sets 4−6 show multiple peaks in the power spectrum with maxima near $0\overset{d}{.}080$ and $0\overset{d}{.}046$. Sets 7−9 show distinct variability pattern with predominating peak at $0\overset{m}{.}038$ in the power spectrum.
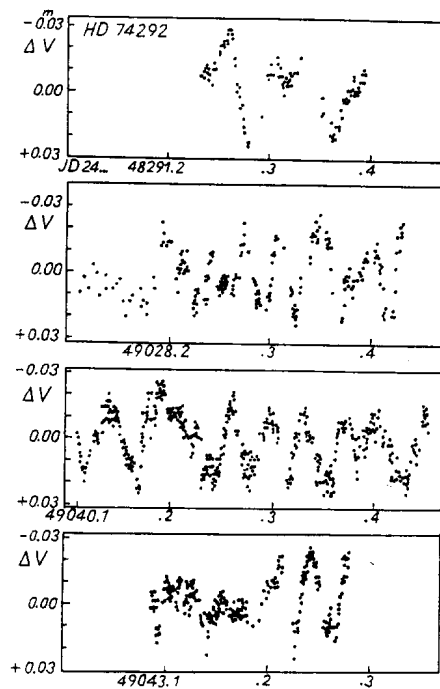
Figure 1. Light curves of HD 74292

On the base of the spectrum, color indices and parameters of oscillations, HD 74292 may be classified as a δ Scuti type variable.

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MAGNITUDE SEQUENCES IN THE FIELDS SURROUNDING UX ANTLIAE AND UW CENTAURI

UX Ant (HV 966) was discovered and first studied by Erro (1940). Though for some time it was considered a suspected member of the R Coronae Borealis (R CrB) type of variable stars (Erro, 1940; Kholopov, 1985) more recently, suggestions were made that it is a true member of the class (Kilkenny and Westerhuys, 1990; Milone et al., 1990).

UW Cen is a typical R CrB type variable star, first studied by Gaposchkin (1952). From maximum to minimum light it has a rather large variation: 7 magnitudes.

Magnitude sequences in variable star fields can be useful in several respects, e.g., for determining light curves, or for knowing approximately the variable brightness at any moment, etc. UX Ant and UW Cen are quite dissimilar examples (at least, if we consider frequency of large light variations!) of what an R CrB type variable star is: from 1980 to 1990, UX Ant exhibited only one deep light minimum (Minniti, 1990); on the contrary, UW Cen frequently shows drops in brightness amounting to several magnitudes from its maximum light. Monitoring these stars would be interesting and a near-by magnitude sequence could facilitate things. Consequently, sequences observed in their fields are presented here.

UBV observations were made with the 60 inch reflecting telescope at the Bosque Alegre Astrophysical Branch of the Córdoba Astronomical Observatory and a single channel photoelectric photometer; they were reduced employing UBV standard stars from E regions (Cousins, 1972, 1983). An RCA 1P21 photomultiplier and standard UBV Schott glass filters were used (Kron, 1963). The field was usually diaphragmed to 10 arc seconds during measurements.

The atmospheric extinction was redetermined because early in 1991, several volcanic eruptions occurred in the southern hemisphere. Mean values were employed in the reduction of the observations.
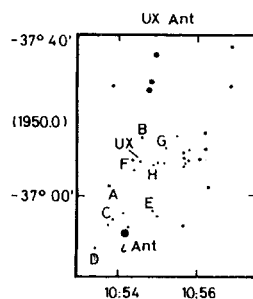
Figure 1. Region around UX Ant
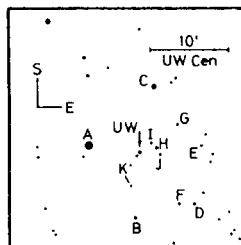
Figure 2. Region around UW Cen

Table I

UX Ant Region				UW Cen Region		
	V	B−V	U−B		V	B−V	U−B
Star A	9.70	0.47		Star A	7.10	0.05	
Star B	10.45	1.00		Star B	8.58	1.14	
Star C	11.48	0.59		Star C	9.32	−0.03	
Star E	11.45	1.03		Star D	10.08	0.37	
Star F	11.78	0.45		Star F	11.22	1.15	
Star G	11.86	1.35		Star G	11.65	0.22	
Star H	13.33	1.23		Star H	11.28	0.35	
UX Ant close				Star I	12.42	1.46	
companion(1)	14.55	0.41		Star J1(5)	13.46	0.65	
UX Ant(2)	11.99	0.53	0.31	Star J2(5)	14.34	0.27	
UX Ant(3)	11.94	0.56	0.23	Star J12(5)	13.06	0.52	
UX Ant(4)	11.88	0.59	0.01	Star K(6)	12.93	0.56	
				UW Cen close			
				companion(7)	13.41	0.78	0.20

(1) A star 15 arc seconds to the NW of UX Ant.

(2, 3, 4) Observations made in 1992, April 24 (02:07 UT), May 1 (00:42 UT) and May 31 (23:46 UT), respectively (JD 2448736.59, 48743.53 and 48774.49).

(5) J is a double star; J1 and J2, bright and faint component, respectively; J12, combined magnitude and color.

(6) Double; combined magnitude and color.

(7) A star some 20 arc seconds to the NNW of UW Cen.

Observations were carried out from April to June 1992. During this period, UW Cen was rather faint and it was not photoelectrically observed. Measured magnitudes and colors are shown in Table I and the observed stars are identified in Figures 1 and 2 (these are only approximate reproductions and it may be useful to supplement them with published photographs, e.g., Papadopoulos (1979), or Milone (1990).

Our measured V, B−V, and U−B for UX Ant are similar to the values published by Kilkenny & Westerhuys (1992) (V=12.05, B−V=0.55, U−B=−0.02) and are consistent with the generally accepted idea that these stars show (usually small) light variations even at their maximum brightness. Also, measured colors for UX Ant nearly coincide with mean values obtained for RX Sgr at its maximum (Lawson et al., 1990); B−V≈0.60, U−B≈0.30, and in turn, they seem to be a little reddened (0.1, or 0.2, in B−V) as these two stars have mid to late F spectra.

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II-52 – A NEW SHORT PERIOD VARIABLE STAR IN M3

II-52 (Sandage, 1953) is located at the lower part of the red giant branch (see Figure 1). Its brightness is fainter than that of the horizontal branch by about one magnitude. The magnitude and colors of the star are V=16.77, B−V=0.65, U−B=−0.01 (Johnson and Sandage, 1956). The coordinates of the star relative to the cluster center are: x=65", y=257". Unfortunately, neither radial velocity nor proper motion determinations are found in literature. To assign the membership of a star according to its position in the C−M diagram (photometric criteria) generally agrees with the proper motion determinations in M3, however, the photometric criteria assigned a few field stars to the cluster and vice versa (Cudworth, 1979).

Surprisingly, II-52 appears to be a new short period variable star. The CCD data we used and the procedure for analysing the variation are the same as those used before (Yao et al., 1993a, 1993b). The same star AO was used as the comparison star. A frequency of $\nu \cong 3.92$ with a height of Z=20.36 in the periodogram was searched out, i.e., the false alarm probability F must be very low and the variation of the star is real. However, due to the fact that II-52 is fainter than AO by about two magnitudes, the photometric precision is not as high as that for vZ1140 and vZ1055 (Yao et al., 1993a, 1993b). The folded light curve is shown in Figure 2 which can be represented by the following formula:

$$\Delta m(t) = 2.10 + 0.01716 \sin(2\pi t/P + 2\pi\phi)$$

Figure 1

2
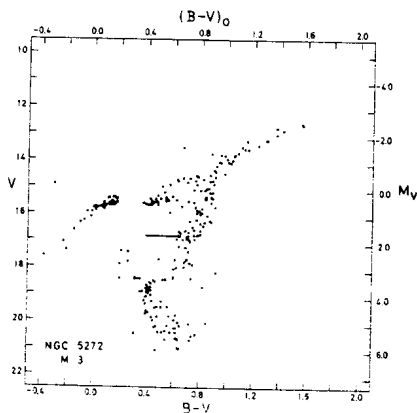
(II−52) − AO
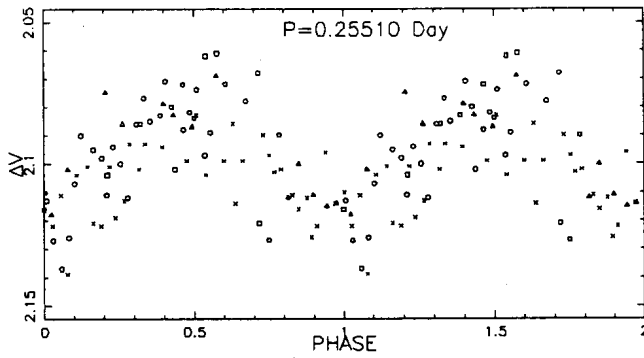
P=0.25510 Day
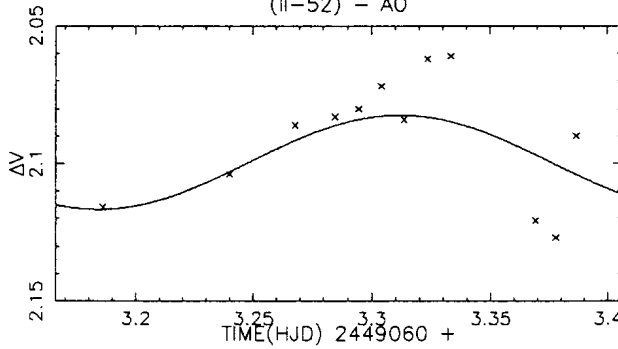
Figure 2

(II−52) − AO

Figure 3

Here the 2.10 is the mean magnitude difference between II-52 and AO, P=0.25510 day, ϕ=0.7670. The "real time" light curves are shown in Figures 3, 4, 5, 6. The symbols in the figures are the same as before (Yao et al., 1993a).

We also used another comparison star (II-58) to check the result, a slightly different period P=0.25306 day was found. The similar folded light curve is shown in Figure 7. Though the magnitude and color of II-58 (V=16.66, B−V=0.67) are similar to that of II-52, the scatter in Figure 7 is larger than that in Figure 2 due to the faintness of both II-52 and II-58.

As far as we know, this is the first report on the variation of a star located at such a position in the C−M diagram (if II-52 is really a cluster member). We hope that the result will be checked by other observers independently.
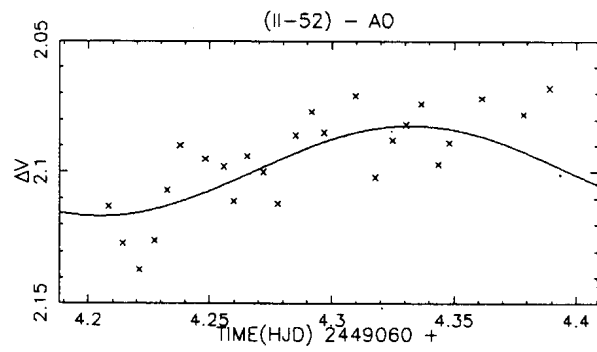
Figure 4

Figure 5

Figure 6

4

$(II-52) - (II-58)$

P=0.25306 Day
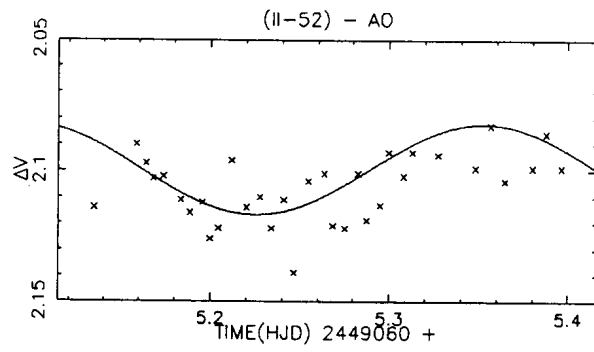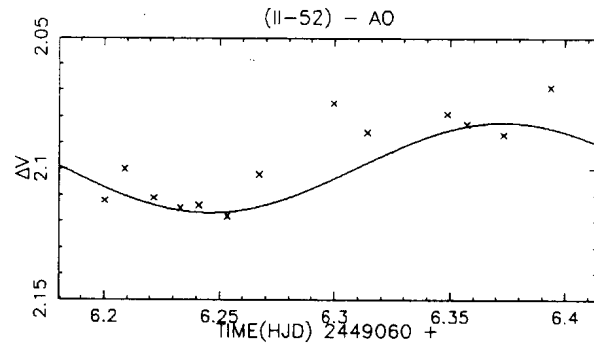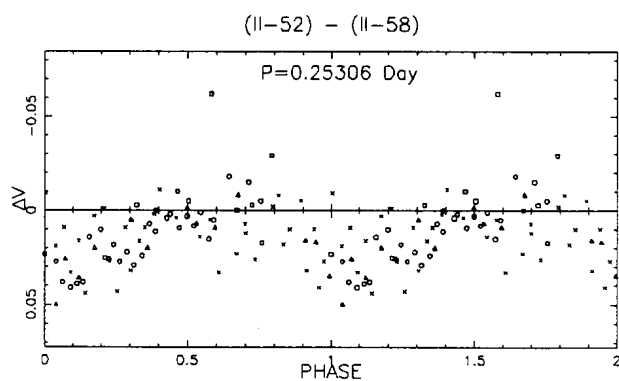
Figure 7

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V447 Cas = NSV 269

During my work on *PICA project* (= Precise Identification and Coordinate Adjustment of about 7000 variables) I have found that *V447 Cas* is identical with *NSV 269*.

V447 Cas = *Wr 176* was discovered by Weber (1968). His paper contains basic information together with finding chart. Although poorly studied, this star has received its final designation in 1970 (Kukarkin et al., 1970).

NSV 269 = *S 10151* was discovered by Hoffmeister (1967a) in the same time as *Wr 176*. Fortunately finding chart for this star was also published (Hoffmeister, 1967b). No final designation was accepted for this star and it was included into New Catalogue of Suspected Variable Stars (Kholopov et al., 1982).

While working on field variable stars around *NZ Cas* I have noticed that both above mentioned charts refer probably to the same star. Additional check has confirmed this, showing also the reported coordinates of both stars being somewhat off the star's real position. As this star is identical with GSC 3667.0737 the correct coordinates were easily found (see Table 1). Finding chart (see Figure 1) was adapted from Atlas Stellarum (Vehrenberg, 1970).

Following cross-identifications are valid : V447 Cas = Wr 176 = S 10151 = = GSC 3667.0737

Name	Position (B1950)		Position (J2000)		Type	Max	Min	Phot.
	h m s	° '	h m s	° ' "		mag	mag	system
NSV 269	00 40 57	+59 35	00 43 52	+59 51	LB	12.5	13	p
V447 Cas	00 41 13	+59 33	00 44 08	+59 40	LB	12.5	14.0	p
GSC 3667.0737			00 43 43.81	+59 50 12.9		9.8		J

Table 1: Comparative table of *original* data for NSV 269, GSC 3667.0737 and V447 Cas. Data concerning NSV 269 are from NSV, data for V447 Cas are from GCVS and data for GSC 3667.0737 are from GSC.
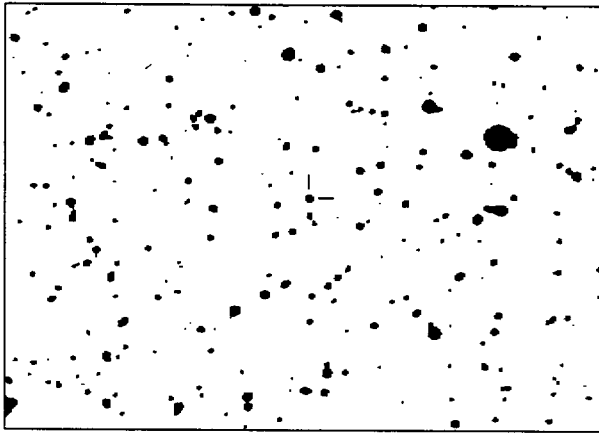
Figure 1: Finding chart for V447 Cas = NSV 269. The chart covers about 40' x 30' with north up. Variable is marked with two short lines.

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UBV photoelectric and photographic photometry of
Nova Cassiopeiae 1993

Nova Cassiopeiae 1993 has been discovered by K. Kanatsu on Dec. 7, 1993 (*cf.* IAU Circ. 5902). Munari *et al.* (1994) have reported on BVI photographic photometry of the progenitor on patrol plates obtained over the period 1970-1985 at the Asiago Astrophysical Observatory.

Nova Cas 1993 belongs to the rare group of *DQ Her*-type novae (*cf.* IAU Circ. 5925, 5945). In this note we present UBV photoelectric and photographic photometry secured up to the beginning of the rapid fading event characterizing this type of novae. The data have been collected at a number of sites using different instrumental set-ups. The results are collected in Table 1.

Photographic photometry has been secured with the 67/92 cm Schmidt telescope in Asiago (Italy), which is operated by the Astronomical Observatory of Padova. The filter + emulsion combinations are: U=103a-O(plate) + UG2, B=103a-O(plate) + GG13, V=T-Max400(film) + GG14. The magnitude of the nova has been measured with an Iris microphotometer against a set of comparison star extracted from the SIMBAD database in Strasbourg. The Asiago data are labelled *As* in Table 1.

Additional photographic photometry has been obtained with the twin 0.25 cm f/3 Schmidt cameras at the private observatory of one of us (I.D.). The filter + emulsion combinations are: U=103a-O(film) + UG2, B=103a-O(film) + GG13, V=T-Max400(film) + GG14. The magnitude of the nova has been measured with an Iris microphotometer against the same set of comparison stars used to reduce the Asiago photographic data. These data are labelled *D* in Table 1. Photographic photometry has been also secured in the V band with a f=30 cm Zeiss lens of the Associazione Friulana di Astronomia e Meteorologia (AFAM), Udine, Italy. A combination T-Max3200(film) + commercial yellow filter (matching the GG14 transmission curve) was adopted and the magnitude of the nova was estimated visually at the microscope against the same set of comparison stars used for the Asiago photographic photometry. These data are labelled *P* in Table 1.

When the photographic data in Table 1 are given with two decimal figures, this means that more than one plate or film (generally from 3 to 6) were obtained and the reported

Table 1: UBV photometry of Nova Cassiopeiae 1993. The telescope identification is given in the text.

Date		JD	U	B	V	Telescope
Dec. 12	1993	2449334.34			6.7	As
Dec. 16	1993	2449338.30	6.6	6.6	5.9	As
Dec. 16	1993	2449338.31	6.4	6.63	6.1	D
Dec. 17	1993	2449339.28		6.4	5.7	As
Dec. 17	1993	2449339.29	5.99	6.17	5.53	Bk
Dec. 17	1993	2449339.34	6.19	6.14	5.71	D
Dec. 18	1993	2449340.33	7.35	6.90	6.24	D
Dec. 18	1993	2449340.37	7.68	7.15	6.22	Bk
Dec. 18	1993	2449340.42		7.2	6.4	As
Dec. 19	1993	2449341.30	7.22	7.24	6.46	Bk
Dec. 22	1993	2449344.34			6.7	P
Dec. 23	1993	2449345.29			6.9	P
Dec. 27	1993	2449349.38			6.4	P
Dec. 28	1993	2449350.23			6.7	P
Dec. 29	1993	2449351.28	7.10	7.70	7.23	Af
Dec. 30	1993	2449352.23	6.9	7.30	6.9	D
Dec. 30	1993	2449352.25			7.0	P
Jan. 2	1994	2449355.42			6.8	P
Jan. 12	1994	2449365.24			7.0	P
Jan. 14	1994	2449367.29	6.93	7.70	7.31	Rz
Jan. 15	1994	2449368.27			7.5	P
Jan. 15	1994	2449368.31	7.12	7.85	7.45	Rz
Jan. 16	1994	2449369.24			7.6	P
Jan. 18	1994	2449371.25			7.7	P
Jan. 18	1994	2449371.31	7.32	7.77		D
Jan. 19	1994	2449372.25	7.46	8.06	7.81	Rz
Jan. 19	1994	2449373.29	7.25	7.91		D
Jan. 21	1994	2449374.35			7.8	P
Jan. 22	1994	2449375.23		7.97	7.64	Af
Jan. 22	1994	2449375.26			7.7	P
Jan. 24	1994	2449377.25	7.3	8.0	7.6	As
Jan. 25	1994	2449378.24	7.4	8.0	7.6	As
Jan. 26	1994	2449379.25			7.5	P
Jan. 27	1994	2449380.27			7.9	P
Jan. 28	1994	2449381.24			7.9	P
Jan. 29	1994	2449382.30			7.8	P
Jan. 30	1994	2449383.25			8.0	P
Jan. 31	1994	2449384.23			7.8	P
Jan. 31	1994	2449384.31	7.50	8.25	7.4	D
Feb. 4	1994	2449388.28	8.12	8.78	8.61	Rz
Feb. 7	1994	2449391.25			7.9	P
Feb. 9	1994	2449393.28	8.3	8.72	8.3	D
Feb. 10	1994	2449394.26			8.2	P
Feb. 11	1994	2449395.29	8.29	8.70		D
Feb. 14	1994	2449398.25			8.4	P
Feb. 15	1994	2449399.27			9.0	P

value is the mean of the individual magnitudes. The internal errors associated to these mean photographic values are of the order of ~0.04-0.06 mag.

Photoelectric photometry was obtained at three sites against the same set of comparison stars (primary star: HD 223173, U=8.92, B=7.17, V=5.52). We used the photoelectric photometer attached at the 0.45 m reflector of AFAM (data labelled *Af* in Table 1), which has been briefly described by Munari *et al.* (1993). We also used the two identical photometers attached at the 0.6 m telescopes of the National Astronomical Observatory in Rozhen and the Astronomical Observatory of Belogradchik, Bulgaria (respectively labelled *Rz* and *Bk* in Table 1). The internal errors of the photoelectric photometry are of the order of 0.01-0.04 mag in all bands.

The photometry in Table 1 confirms (*cf.* IAU Circ. 5902-5945) that Nova Cas 1993 experienced substantial brightness fluctuations – even on short time scales – before the onset the deep *DQ Her*-type minimum. We made two attempts to detect flickering-like variability. We observed Nova Cas 1993 in U band with the photoelectric photometer attached to the 0.6 m telescope in Rozhen and 1^{sec} integration time. The observations extended from UT 19.45 to 21.00 on Jan. 14 and from UT 19.65 to 21.05 on Jan. 15, 1994. No flickering-like variability was detected, the readings being stable at a 0.015 mag level.

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Improved Positions of Southern NSV Stars. III

This is the third in a series of notes aimed to provide accurate coordinates of southern NSV stars. Previous results can be found in Lopez and Lepez (1993) and Lopez and Torres (1994) while details and general procedures on the program may be found in Lopez and Girard (1990).

Table 1 lists the newly determined positions. The first column gives the NSV number; the second and third provide the RA and Dec (equinox B1950.0), respectively; the fourth column is the epoch of observation (given as epoch *minus* 1900); the last two columns list the differences between our new positions and those quoted in the NSV catalogue in minutes of time in RA and arc minutes in Dec. The differences are in the sense new positions *minus* NSV coordinates.

The 95 objects listed in Table 1 added to the 558 already reported by Lopez and Girard (1990), Lopez and Lepez (1993), and Lopez and Torres (1994) bring to 653 the total number of NSV stars for which we have been able to improve their positions.

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TABLE I

Improved Positions of Southern NSV Stars

Star	RA			(1950.0)	Dec		Epoch	ΔRA	ΔDec
	h	m	s	°	'	"		m	'
10905	18	27	2.30	-43	50	44.8	68.57	-0.162	-0.447
10906	18	27	15.78	-44	45	35.6	68.57	+0.030	-0.094
10929	18	27	48.00	-42	38	15.7	68.57	+0.000	+0.039
10940	18	28	15.07	-46	40	36.6	68.57	+0.035	+0.191
10941	18	28	14.19	-42	38	9.9	68.57	-0.014	+0.435
10953	18	28	48.86	-43	5	21.9	68.57	+0.064	-0.264
10971	18	29	6.10	-47	29	6.2	68.57	-0.032	-0.303
10975	18	29	14.27	-43	28	56.3	68.57	+0.021	-0.039
10979	18	29	24.46	-65	4	45.0	70.30	-0.042	-0.450
10991	18	29	41.87	-63	14	25.9	70.43	-0.085	+0.268
10995	18	29	57.33	-61	35	51.8	70.59	+0.039	+0.436
11028	18	31	7.57	-44	43	32.4	68.61	-0.041	-0.339
11036	18	31	31.97	-42	44	56.4	68.61	+0.050	+0.360
11046	18	32	2.22	-61	54	40.2	70.51	+0.004	+0.030
11083	18	33	35.02	-46	29	49.6	68.61	0.000	+0.174
11088	18	33	43.46	-47	8	39.3	68.64	+0.008	-0.256
11099	18	34	2.55	-41	53	54.2	69.01	-0.057	-0.004
11102	18	34	17.35	-47	13	18.3	68.61	+0.006	-0.005
11110	18	34	36.55	-40	4	1.4	69.38	-0.041	+0.377
11116	18	34	54.13	-44	51	17.5	68.61	+0.019	-0.391
11135	18	35	35.91	-44	45	52.7	68.61	-0.001	-0.279
11166	18	37	4.57	-45	15	56.9	68.61	+0.009	-0.349
11172	18	37	18.82	-44	20	58.3	68.61	+0.014	+0.429
11190	18	37	55.03	-42	3	21.5	68.87	-0.016	-0.058
11191	18	37	56.08	-41	1	30.0	69.38	-0.049	-0.200
11210	18	39	1.57	-40	45	3.5	69.38	-0.024	-0.358
11213	18	39	9.44	-40	34	20.8	69.38	-0.026	-0.146
11217	18	39	15.51	-43	14	18.4	68.61	-0.008	-0.106
11218	18	39	18.19	-45	35	52.3	68.61	-0.014	-0.372
11229	18	39	47.11	-42	37	27.9	68.87	-0.015	+0.535

TABLE I (cont.)

Star	RA		(1950.0)		Dec		Epoch	ΔRA	ΔDec
	h	m	s	°	'	"		m	'
11239	18	40	2.59	-47	24	35.7	68.61	+0.010	-0.495
11240	18	40	1.76	-43	57	20.4	68.61	-0.021	-0.239
11242	18	40	10.63	-65	30	36.7	70.43	+0.011	+0.288
11244	18	40	13.74	-46	13	47.4	68.61	+0.012	-0.290
11249	18	40	28.71	-42	30	34.6	68.87	-0.055	+0.623
11253	18	40	51.54	-58	16	39.2	70.59	+0.042	+0.247
11257	18	40	58.64	-47	11	4.8	68.61	-0.023	+0.020
11262	18	41	10.95	-47	16	31.3	68.61	-0.017	-0.321
11269	18	41	31.25	-47	12	45.1	68.61	-0.012	+0.149
11274	18	41	39.20	-46	28	37.3	68.61	-0.013	+0.378
11291	18	42	18.93	-47	38	1.5	68.61	-0.018	-0.625
11296	18	42	32.45	-62	55	55.9	70.51	-0.026	+0.068
11305	18	42	45.27	-63	43	24.8	70.43	-0.045	-0.012
11318	18	43	16.95	-47	24	29.8	68.64	-0.018	-0.396
11325	18	43	40.22	-61	3	37.9	70.59	-0.013	+0.068
11336	18	44	23.09	-46	28	57.7	68.64	-0.015	-0.262
11340	18	44	43.91	-58	20	17.7	70.59	+0.032	-0.095
11350	18	45	9.69	-63	37	9.3	70.43	-0.055	-0.156
11354	18	45	25.87	-41	25	25.2	69.38	-0.002	-0.221
11376	18	46	53.97	-42	17	53.9	69.01	0.000	+0.101
11391	18	47	33.59	-43	14	40.8	68.64	-0.007	-0.181
11396	18	47	39.23	-45	19	18.3	68.64	+0.021	-0.204
11406	18	48	5.74	-60	53	20.7	70.14	-0.021	+0.054
11446	18	49	46.99	-41	30	30.8	69.38	-0.017	-0.014
11448	18	49	53.11	-45	28	46.4	68.64	+0.035	-0.373
11472	18	50	48.29	-40	57	3.2	69.38	+0.022	+0.347
11503	18	51	58.51	-39	41	51.2	69.38	+0.025	+0.047
11539	18	53	6.03	-44	43	54.5	68.64	+0.067	-0.109
11547	18	53	13.57	-45	49	58.2	68.64	+0.010	-0.369
11560	18	53	55.90	-45	32	11.7	68.64	+0.015	-0.596
11562	18	53	46.88	-41	3	28.1	69.38	-0.152	-0.268
11564	18	53	56.44	-64	30	16.5	70.40	-0.059	+0.324
11580	18	54	40.68	-43	4	19.0	69.01	-0.005	+0.284

TABLE I (cont.)

Star	RA			(1950.0)	Dec		Epoch	ΔRA	ΔDec
	h	m	s	°	'	"		m	'
11603	18	55	53.98	-40	34	37.3	69.38	0.000	-0.322
11619	18	56	43.94	-59	11	39.2	70.14	-0.068	+0.547
11620	18	56	51.35	-42	6	39.6	69.01	+0.006	-0.260
11645	18	58	19.92	-44	14	17.1	68.64	+0.015	+0.115
11660	18	59	15.18	-41	49	25.1	69.38	-0.030	-0.218
11665	18	59	21.90	-41	18	32.6	69.38	+0.032	-0.043
11666	18	59	20.43	-42	4	40.3	69.01	+0.007	+0.428
11670	18	59	25.78	-58	21	47.6	69.69	+0.013	+0.207
11672	18	59	39.97	-46	3	4.7	68.64	+0.016	+0.122
11682	19	0	15.67	-42	44	43.7	69.01	+0.028	+0.672
11686	19	0	21.78	-57	30	12.6	69.69	-0.004	-0.010
11698	19	1	26.23	-57	39	9.9	69.69	+0.020	+0.035
11706	19	2	1.65	-44	26	31.3	68.64	+0.011	+0.078
11721	19	2	57.76	-40	57	3.7	69.38	-0.021	-0.061
11731	19	3	25.97	-45	57	27.9	68.64	+0.016	+0.336
11732	19	3	30.25	-40	23	20.5	69.38	+0.021	+0.058
11734	19	3	42.90	-45	59	51.5	68.64	+0.048	+0.441
11747	19	4	31.31	-43	55	29.9	68.64	+0.005	-0.098
11751	19	5	15.53	-47	18	58.3	68.64	-0.008	+0.228
11758	19	5	54.51	-45	40	49.2	68.64	+0.025	+0.179
11764	19	6	28.50	-47	47	13.0	68.64	+0.008	+0.084
11770	19	6	51.07	-58	43	24.0	69.69	+0.051	+0.100
11784	19	8	20.15	-57	39	7.9	69.69	+0.053	+0.168
11787	19	8	26.12	-66	26	34.4	70.40	-0.015	+0.027
11794	19	8	56.45	-66	51	33.2	70.40	-0.109	-0.253
11803	19	10	8.45	-61	20	51.6	69.69	+0.341	+0.040
11821	19	10	49.49	-60	32	36.3	69.69	+0.008	-0.305
11843	19	12	29.44	-58	22	33.7	69.69	+0.057	-0.061
11909	19	17	19.53	-60	54	31.8	69.69	-0.091	+0.070
11934	19	18	47.16	-64	26	51.3	70.36	-0.047	+0.546
12217	19	35	15.80	-63	49	21.5	70.36	+0.030	+0.642
12268	19	37	29.08	-64	11	41.9	70.36	+0.001	-0.099

PHOTOELECTRIC INTERMEDIATE BAND
PHOTOMETRY OF SN 1993J

SN 1993J has been the brightest supernova in the northern hemisphere for the last decades. It has been monitored photometrically mainly by broad band photometry using CCD-images. As a result, mostly $BVRI$ measurements were obtained, omitting information on the U-colour.

Deviating from this general line we have decided to carry out a 6 filter photoelectric photometry, both to include information on the near ultraviolet and on other filters in the visual domain to be compared to the broad band colours.

The filter set comprises the Stroemgren filters u (352.6 nm, HW 16.0 nm), v (410.1 nm, HW 21.4 nm), b (467.0 nm, HW 19.5 nm), y (547.3 nm, HW 18.8 nm) and two additional filters with central wavelengths between b and y, i.e. $g1$ (501.7 nm, HW 12 nm) and $g2$ (521 nm, HW 12 nm). The latter two filters have been described by Maitzen and Floquet (1981).

The measurements have been carried out at the 1m telescope of the Purgathofer Observatory (Klosterneuburg nr. Vienna) by one of us (RP). A novel type of photoelectric photometer has been used: it contains a rapidly rotating filter wheel, but with fast stop (=filter measurement, in our case 60 milliseconds) and go (20ms) motion. The photomultiplier (EMI 6256B) was operated at 1170 V and Peltier-cooled. A more detailed description of this photometer can be found in Pressberger and Stoll (1993).

Due to the proximity of urban light (mostly from Vienna which, however, fortunately is minimized in our case since it is situated to the SE, while SN 1993J was in the NW direction) the sky contribution had to be reduced as far as possible employing a *very small diaphragm* (6.6 arc seconds). Although such a small size is prohibitive for bright star and millimag precision work, it is useful in our case also for reducing the galaxy background of M81. The very good tracking and frequent monitoring of centering enabled us to reach an acceptable precision close to the Poisson limit.

As *comparison star* the nearby star 'B' = GSC 4383.0928 was used. Its proximity renders all differential extinction corrections negligible. Stroemgren indices were derived tying this star to the bright stars HD 87141, HD 87243 and HD 90508 observed on Jan. 18, 1994 at nearly the same airmasses. This way we obtain:

$V = 11.91$, $b - y = 0.335$, $m1 = 0.157$ and $c1 = 0.300$. The corresponding mean errors are 0.030, 0.014, 0.015 and 0.019 mags, respectively. Following the study of Oblak et al. (1976) these colours indicate an F7V type star with zero reddening. From Relyea and Kurucz (1978) we quote $\log g = 4.2$ for these indices in perfect accord with the foregoing luminosity class.
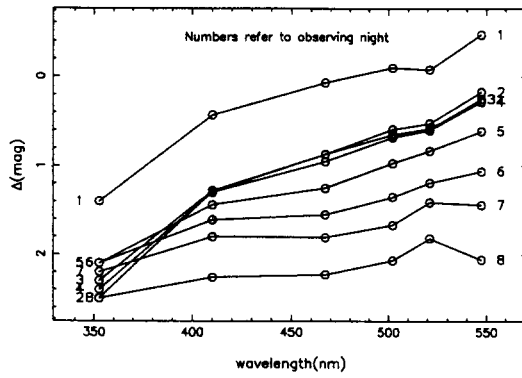
Figure 1. SN 1993J – GSC 4383.0928
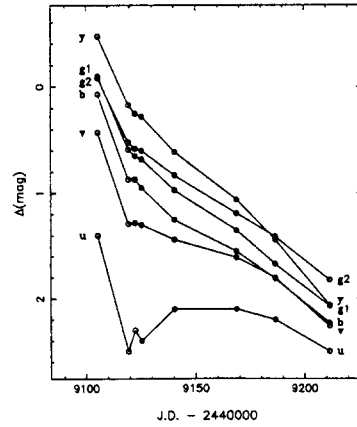
Figure 2. Light curves SN 1993J – GSC 4383.0928

Table 1. Differential 6-colour photometry of SN 1993J

No.	JD-2440000	Date (1993)	Δu	Δv	Δb	$\Delta g1$	$\Delta g2$	Δy	V
1	9105.39	Apr 27.89	1.4	0.43	0.07	-0.10	-0.08	-0.47	11.44
2	9119.41	May 11.91	2.5	1.29	0.87	0.59	0.52	0.17	12.08
3	9122.41	May 14.91	2.3	1.28	0.87	0.65	0.58	0.25	12.16
4	9125.39	May 17.89	2.4	1.30	0.95	0.68	0.60	0.28	12.19
5	9140.39	Jun 01.89	2.1	1.44	1.25	0.97	0.83	0.61	12.52
6	9168.43	Jun 29.93	2.1	1.61	1.55	1.35	1.19	1.06	12.97
7	9186.43	Jul 17.93	2.2	1.80	1.81	1.67	1.41	1.44	13.35
8	9211.40	Aug 11.90	2.5	2.26	2.23	2.07	1.82	2.06	13.97

The *differential observations* were carried out on 8 nights spanning the interval Apr. 27 to Aug. 11, 1993. SN, star 'B' and sky alternated 2 - 3 times on each night, one measurement set per object consisting of 5 integrations after each of which recentering in the diaphragm was done. One such integration typically comprised 200 filter wheel rotations yielding 12 seconds total measuring time for each filter.

The *average precision* for the nightly magnitude differences is 0.02 mag, except for u which should be accurate to 0.1 mag. In Table 1 we list the results of the 8 observing nights. Partially, they have been previously published by us in the IAU circulars (Pressberger and Maitzen, 1993).

In Fig. 1 we display the *differential flux distributions* with wavelength. Inspection of this picture immediately reveals the blueing of the optical flux during the interval covered, most of which is dominated by the exponential brightness decrease due to radioactive decay of Co^{56}.

Although with the rather small bandwidth of the filters of our system local spectral features are expected to considerably influence the picture, we notice only one band where this effectively takes place, i.e. $g2$ which changes from a flux deficient band to a flux excess domain. Since the changes in this band are large compared to the adjacent filters y and $g1$ (about 40%), comparison with spectrophotometry would be useful. A certain similarity may be recognized in the case of the ultraslow nova PU Vul which also showed a strong flux excess in the $g2$ band after entering the general emission line phase (Maitzen, Pavlovski, 1994).

Fig. 2 contains the *lightcurves* in 6 colours. The steepest decrease in all filters occurs between nights 1 and 2 ranging from 0.078 in u to 0.046 mags per day in y. Then until night 6 the slope characterizing the exponential decrease is distinctly smaller, strongest in y (0.018 mags per day), weakest in v (0.008 mags per day), whereas in u the brightness even increases to reach a maximum during June. In broad band U Wheeler (1993) also noticed an increase of brightness from May 23-26 until June 8-11 by 0.07 mags. A similar maximum in satellite UV is visible in the IUE observations (Kirshner, 1990) of SN 1987A. The nature of the agent producing the third maximum has not been cleared up. While Kirshner (1990) proposes decreasing UV opacity in the SN atmosphere, Wheeler et al. (1993) assume a "buried source of constant luminosity in addition to the radioactive decay".

From June 29th on there is a general trend to level off from the straight line, probably caused by the beginning of transparency for γ rays. It just occurs at the time predicted by Prugniel and Rau (1993) based on their assessment that the rate of evolution in SN 1993J is generally a factor of 4 faster than in SN 1987A.

Although they did not measure SN 1993J in U their prediction of factor 4 also applies to the duration of the "third" maximum if we compare our u-curve with Kirshner's (1990) IUE curve for the region 300-320 nm. The deviating behaviour of $g2$ has been introduced already in the discussion of Fig. 1. Our decline rates during the exponential phase match very well with B and V results: e.g. Prugniel and Rau (1993) derive 0.009 and 0.018 mags per day, respectively.

4

In *conclusion* we may state that our photometry :

a) establishes similarity of 1993J and 1987A ultraviolet (roughly 300-350 nm) light curve behaviour concerning the existence of a third maximum,

b) confirms the factor 4 in evolution speed also with respect to the duration of this maximum,

c) verifies the factor 4 concerning the onset of γ ray transparency,

d) exhibits decline rates for the violet to yellow filters which are in very good accord with published B and V results, except

e) the behaviour in the $g2$-filter showing a 40% increase in flux relative to the mean value of the adjacent filters $g1$ and y during the observing period, and

f) demonstrates a general blueing of the flux distribution.

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A PHOTOMETRIC STUDY OF THE
NEW ECLIPSING BINARY HD 21155

HD 21155 is an eighth magnitude B8 star that was discovered to be a 3^d045 eclipsing binary by Kaiser (= DHK 9) some five years ago (Baldwin & Kaiser 1989). Very little is known about the system but visual observations reveal a primary minimum of ~ 0.4 mag and the secondary minimum is not seen. Photoelectric observations around phase 0.5 (Kaiser et al. 1990) put an upper limit on the secondary minimum of ~ 0.03 mag, so it is possible that the true period is ~ 6 d. However, the visual and photographic observations show no differences between alternate minima.

New photoelectric observations of this system have been made on 47 nights during 1991 to 1993 from Catsfield, East Sussex in southern England with a 25-cm Newtonian equipped with a prototype JEAP (EMI9924B PMT based) photon-counting photometer (Walker 1986, 1991) and computer controlled data acquisition. All the observations were made with a nominal V filter and integration times were 30 seconds through a 1 arc minute aperture. The comparison and check stars were HD 21193 and HD 21099 respectively and the sequence, comparison – sky – variable – check was repeated between 2 (one night only) and 6 times for each observation. The mean Δm magnitudes, variable minus comparison and comparison minus check, and their errors were calculated. The standard deviation of the comparison minus check star measurements (both stars are fainter than the variable) is 0.026 mag.

The magnitude differences, variable – comparison, are plotted in Figure 1, using the ephemeris

$$\text{HJD}_I = 2435988.336 + 3.0452976 \times E$$

given by Kaiser et al. (1990). The plot shows a well defined primary minimum of $\sim$ 0.44 mag and strong indication of secondary minimum of ~ 0.04 mag. If the secondary eclipse has been detected then it confirms that the period given in the ephemeris is correct, as opposed to twice that value. Unfortunately all the observations in the core of primary minimum are from the same (6 day) minima, so it is not possible to provide the additional confirmation of identical alternate minima. Nevertheless, the secondary minimum, although small, seems well established. The time of primary minimum derived from these observations is

$$2449049.621 \pm 0.007,$$

and has an O–C of 0.004 days with respect to the ephemeris. Although this timing is arguably the most accurate one available, it does not make any significant improvement to the ephemeris, which should be more than adequate for some years.

An attempt has been made to model the system using Hill's LIGHT2 code. The details will be published elsewhere (Lloyd & Watson 1994) but the results suggest that both components are evolved. The secondary is cool, Te probably < 5000 K, underluminous
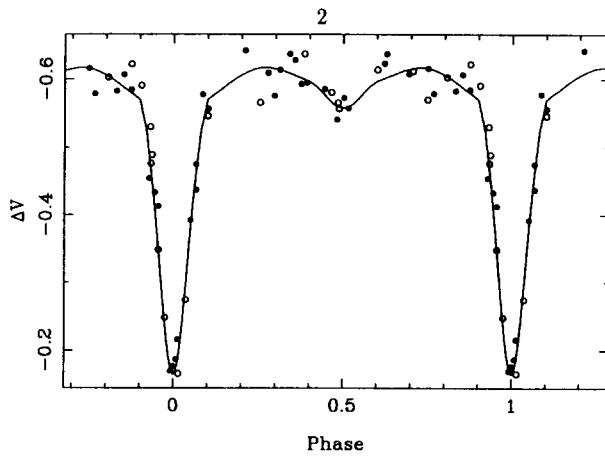
Figure 1. The light curve of HD 21155 from the new photoelectric data. The open
symbols indicate the less reliable data, where the s.e. of the mean Δm's > 0.015 mag.

and probably fills its Roche lobe. The solution plotted in Figure 1 is for a slightly-evolved
B8 primary with R = 5.0 R$\odot$ and a Roche lobe filling secondary of 1.5 M$\odot$, with R = 4.6
R$\odot$ and $T_e = 5000$ K. The standard deviation of the residuals from this line is 0.026 mag,
which is consistent with the observational errors. The evolved, cool, low-mass secondary
clearly indicates that this is an Algol binary.

At present there are no radial velocities of this system, but if it is at all similar to the
solution presented here then the spectroscopic orbit, should have an easily detectable K_1
~ 70 km/sec. Additional photoelectric observations of rather higher precision than those
presented here will be necessary to improve the details of the light curve, but the most
vital requirement is for a radial velocity solution.

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TIMES OF MINIMA OF NINE ECLIPSING BINARIES

We report times of minima of eclipsing binaries derived from photometric observations made with the 0.4 m reflector at Droke Observatory near Fayetteville, Arkansas, and with the 0.6 m Lowell Telescope at Cerro Tololo Interamerican Observatory in Chile. Both photometers used pulse-counting techniques and the observations were corrected for system deadtime and atmospheric extinction. Heliocentric times of minimum were estimated by bisecting chords drawn across the minima. Uncertainties were estimated from differences in the timings in the two filters used – V and R at Droke Observatory and B and V at CTIO – and also differences between independent estimates of the times of each eclipse. Primary eclipses are designated as type 1 eclipses, secondary eclipses as type 2.

Table 1

Star	JD of Min -2400000	Type	Observatory	Observer
SW CMa	49345.6754 ± 0.0006	2	CTIO	Lacy
	49352.6453 ± 0.0004	1	CTIO	Lacy
EK Cep	49248.6416 ± 0.0007	1	Droke	Fox
V477 Cyg	49251.7117 ± 0.0006	1	Droke	Fox
V1143 Cyg	49234.6144 ± 0.0006	1	Droke	Fox
DI Her	49225.6702 ± 0.0012	2	Droke	Fox
FS Mon	49343.7953 ± 0.0005	1	CTIO	Lacy
GG Ori	49355.7327 ± 0.0005	2	CTIO	Lacy
V530 Ori	49341.5832 ± 0.0005	1	CTIO	Lacy
	49353.8048 ± 0.0006	1	CTIO	Lacy
DR Vul	49228.7300 ± 0.0007	2	Droke	Fox

2

The authors would like to thank Jorge Schwarz for his help with some of the Droke Observatory observations.

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NEW PHOTOMETRIC VARIABLE STARS IN THE FIELD
OF SOUTHERN OPEN CLUSTERS

During the course of photometric investigation of the southern open clusters NGC 2354, NGC 2447, Trumpler 10, Collinder 367 and IC 2714, a number of stars were found to be low amplitude photometric variables. These clusters were selected for observation because they have either not been previously observed photoelectrically (NGC 2354 and Cr 367) or the existing data are far from being complete (NGC 2447, Tr 10 and IC 2714). The results of the photometric study of IC 2714 have been recently published by Clariá et al. (1994a), while those of the clusters NGC 2354, NGC 2447, Tr 10 and Cr 367 are being prepared for publication (Clariá and Piatti, 1994).

The purpose of this note is to report the variability detected photoelectrically in eight stars located in the field of the above five clusters. UBV observations of a total of 453 stars in NGC 2345, NGC 2447, Tr 10, Cr 367 and IC 2714 have been carried out during various observing runs between 1991 and 1993. The measurements were performed using the 61-cm and 1-m telescopes of Cerro Tololo Inter-American Observatory (CTIO) and the 2.15-m telescope of the Complejo Astronómico El Leoncito (CASLEO) located in San Juan (Argentina). Dry-ice cooled RCA 31034, EMI 9781A and Hamamatsu R943-02 photomultipliers were used in these observatories with pulse-counting equipments and standard UBV filters. Mean coefficients were employed in CTIO to correct for atmospheric extinction, whereas the coefficients published by Minniti et al. (1989) were used to reduce the CASLEO observations. The UBV standard system was established by nightly observing between 10 and 18 standard stars from the lists of Cousins (1973, 1974) and Graham (1982). The external mean errors of the UBV data are all about 0.01 mag, while the mean internal errors, deduced from the night-to-night dispersion of the program stars, are about 0.02 mag, practically independent of the V magnitude and telescope used.

We have considered a star to be a photometric variable when its individual V magnitudes during different nights display variations larger than five times the mean internal error, i.e., $\Delta v > 0.1$ mag.

Cluster membership was evaluated following the photometric criteria described by Clariá and Lapasset (1986), namely by requiring that the location of a given star in the $V/(B-V)$ and $V/(U-B)$ diagrams correspond to the same evolutionary stage and that the location of the star in the $(U-B)/(B-V)$ diagram be close to the main sequence, the maximum departure accepted being 0.10 mag. The probable membership of star 179 in the field or NGC 2354 was determined by applying the criteria described by Clariá and Lapasset (1983). Finding charts for the new variables in Tr 10 and Cr 367 are shown in Figures 1 and 2. The new variables found in NGC 2354, NGC 2447 and IC 2714 are shown in the finding charts published by Dürbeck (1960), Becker et al. (1976), and Clariá et al. (1994a), respectively.

Table 1

Individual UBV data of new variable stas found in five southern open clusters

NGC 2354 (Dürbeck, 1960)

Star	V	B−V	U−B	Sp. Type	Membership
179	11.36	0.88	0.48	G2	m
	11.49	0.85	0.53		

NGC 2447 (Becker et al., 1976)

Star	V	B−V	U−B	Sp. Type	Membership
39	12.81	0.35	0.01	F2	nm
	12.45	0.46	0.05		
	12.52	0.37	0.03		
	12.73	0.35	0.05		
72	13.01	0.37	−0.01	F5	nm
	12.78	0.49	0.09		
	13.14	0.38	0.01		
77	13.35	0.38	−0.05	F6	nm
	13.24	0.41	−0.09		

Trumpler 10 (Figure 1)

Star	V	B−V	U−B	Sp. Type	Membership
29	11.20	0.30	0.15	F0	pm
	11.06	0.31	0.11		

Collinder 367 (Figure 2)

Star	V	B−V	U−B	Sp. Type	Membership
13	11.45	0.27	0.09	B8−B9	nm
	11.35	0.42	0.27		
101	11.96	0.79	0.35	?	nm
	11.27	1.06	0.58		

IC 2714 (Clariá et al., 1994a)

Star	V	B−V	U−B	Sp. Type	Membership
174	11.83	0.22	0.20	B9V	m
	11.51	0.29	0.28		
	11.57	0.27	0.29		
	11.46	0.34	0.17		
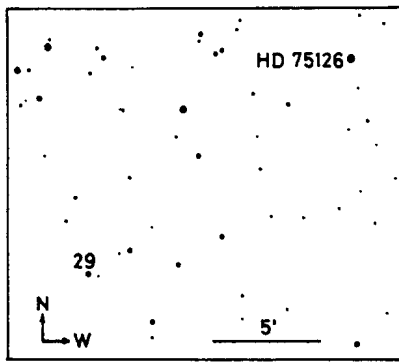
Figure 1. Finding chart for the variable star found in Trumpler 10
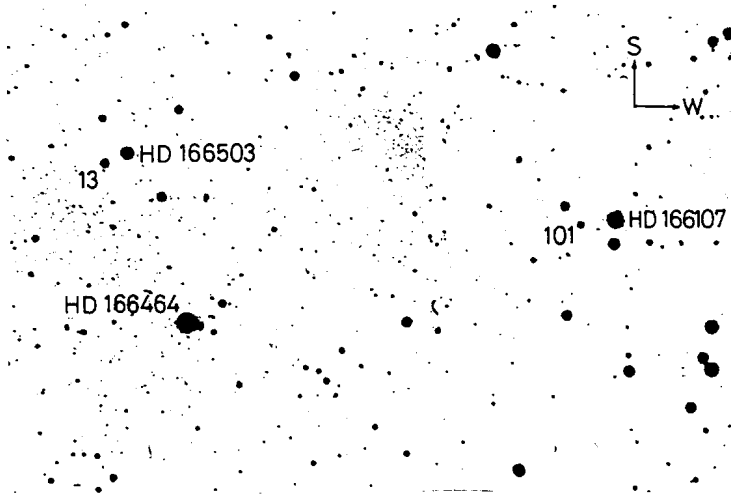
Figure 2. Finding chart for the variable stars found in Cr 367

The individual UBV measurements of the new variables are listed in Table 1. The references for star identifications are given at the head of each section of the table. Column (5) gives the spectral type as estimated from the UBV colours, excepting for star 179 of NGC 2354 whose spectral type was inferred from the unreddened DDO colours using the calibration of Clariá et al. (1994b). The last column of Table 1 indicates if the star is considered to be a cluster memeber, or nonmember.

Among the new variables found there are three which are believed to be members or probable members of the studied clusters, whereas the remaining five stars are very likely field stars. Four of the variables display ΔV variations larger than 0.30 mag and the remaining four stars exhibit ΔV variations between 0.10 and 0.15 magnitudes.

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Differential BV photometry of the EW variable NSV 7457 Her

In a recent paper, Vandenbroere (1993) reported photoelectric photometry of the variable NSV 7457 = BV 103 = BD+50°2255. After a short overview of the observational history of this star, she discusses her photometry which yields the light curve of a typical EW eclipsing binary with the elements:

$JD_{min,hel} = 2447643.1786 + 0.4190306^d \cdot E$ (Vandenbroere, 1993).

In the course of an observing run at the Rosemary Hill Observatory, operated by the Department of Astronomy of the University of Florida, Gainesville, U.S.A., in early 1993, we obtained independent BV photometry, reported here.

The details of our observing procedures are given in Diethelm (1993).
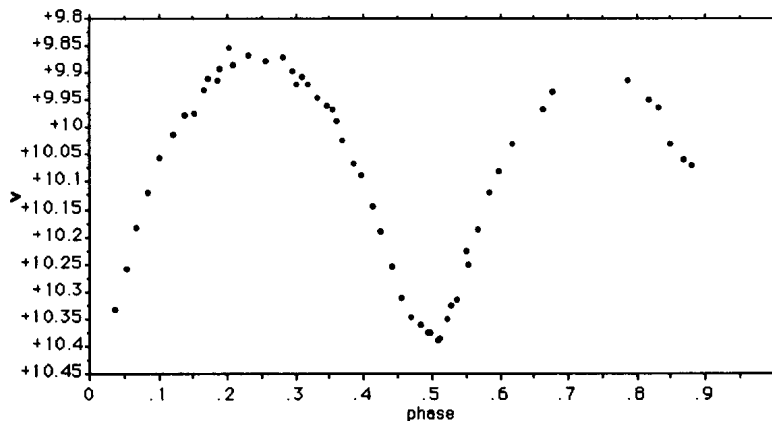
Figure 1: V light curve of NSV 7457 Her

As comparison star, we chose a star about 22s preceding and some 4` north of the variable. This star of similar colour and brightness as NSV 7457 proved to be constant to within the accuracy of the photometry. Using σ Her as check star, we find V = 10.67±0.03 mag and B = 11.10±0.03 mag for this comparison star.

In Figure 1 and 2, we show our 55 measurements in V and B respectively, folded with the elements of Vandenbroere (1993). They were obtained during five nights between JD 2449115 and 2449124. Although the light curve is not completely covered by our observations, they can serve to fully confirm the conclusions drawn by Vandenbroere (1993).

The 29 observations between phases 0.31P and 0.68P, obtained on JD 2449116, 2449122 and 2449124, yield a time of secondary minimum at O = 2449124.65948 ± 0.00012 (mean of determination in both colours with the Kwee-van Woerden (1956) algorithm).
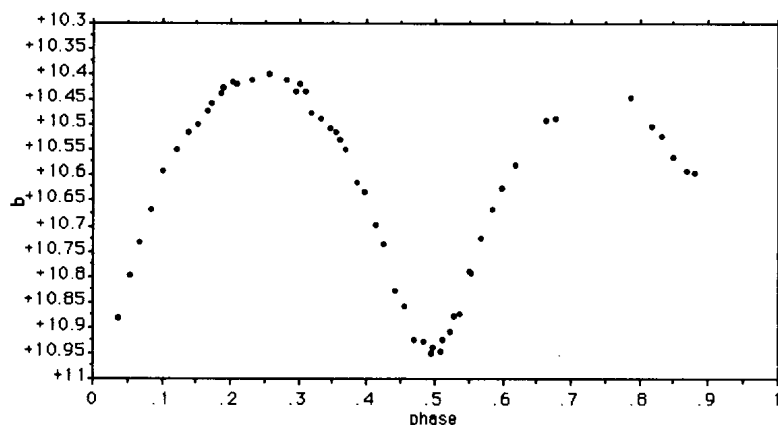
Figure 2: B light curve of NSV 7457 Her

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PHOTOMETRY OF KR AURIGAE 1985-1988[1]

KR Aurigae is a well known prototype of the antidwarf novae class of nova-like variables. Our program for extensive research of variables of this type includes a photometric patrol in B-color of KR Aur in order to continue the long set of already existing observations for construction of long-term light curve of the object. The photometric data, total number 102, obtained in the time interval between JD 2446300, and 2447231 at the NAO "Rozhen" of Bulgarian Academy of Sciences are presented in Figure 1 and Table 1. Observations were made with the 50/70 cm Schmidt, 60-cm Cassegrain and 2-m RCC telescopes. The magnitudes are based on standard stars published by Popova (1965).

Two fadings in the brightness have been observed in this three year period. The greatest observed magnitudes are 15.23 and 15.10. The data published by Götz (1986, 1987) show similar values. It seems that these minima are not as deep as one observed at the end of 1981 (Popov, 1982). It is worth mentioning the remarkable stability of the high state of brightness for more than 400 days since JD 2446557.
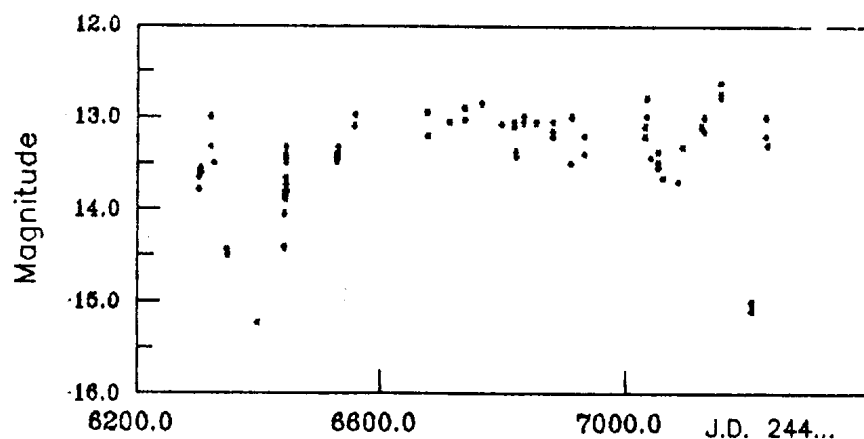
Figure 1

Table 1

J.D. 244...	m	J.D. 244...	m	J.D. 244...	m
6300.581	13.78	442.392	14.42	444.416	13.80
.589	13.66	.406	14.05	.423	13.82
301.588	13.60	.465	14.40	.438	13.74
302.571	13.64	444.256	13.86	.445	13.82
303.564	13.56	.274	13.86	.452	13.74
304.580	13.61	.282	13.84	.482	13.66
320.528	13.33	.290	13.86	.588	13.85
.566	13.00	.300	13.84	.591	13.82
325.573	13.50	.319	13.87	.619	13.89
347.526	14.44	.328	13.84	.647	13.74
348.543	14.50	.399	13.74	.653	13.74
398.602	15.23	.409	13.82	.660	13.74
.675	13.82	677.510	13.20	.538	13.22
.682	13.80	712.618	13.05	.541	13.10
.689	13.82	737.523	12.90	033.598	12.99
445.295	13.46	.613	13.03	034.573	12.79
.328	13.50	765.563	12.85	040.575	13.44
.361	13.46	797.463	13.08	052.557	13.49
.366	13.46	818.232	13.10	.563	13.38
.370	13.42	.226	13.06	.568	13.55
.375	13.45	821.210	13.37	060.603	13.66
.380	13.46	.220	13.42	085.552	13.70
.385	13.40	834.263	12.99	092.579	13.33
.411	13.33	.269	13.05	123.458	13.10
528.345	13.48	854.262	13.06	128.410	13.00
.355	13.4:	.269	13.06	128.508	13.15
.364	13.44	881.293	13.05	155.358	12.75
529.423	13.46	.310	13.22	155.373	12.62
530.437	13.40	.317	13.16	156.360	12.78
531.398	13.33	910.322	13.50	206.479	15.0:
531.412	13.33	911.326	13.0:	.496	15.10
557.412	13.10	932.319	13.40	229.352	13.2:
559.438	12.98	.325	13.20	.394	13.00
676.500	12.95	7 031.535	13.21	232.391	13.30

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DISCOVERY OF 6.2-MINUTE OSCILLATIONS
IN THE Ap Sr STAR HD 86181

Martinez (1993) has obtained Strömgren photometry for all the Ap SrCrEu stars in the first four volumes of the Michigan Spectral Catalogue, along with selected stars classified by Bidelman & MacConnell (1973) north of declination $-12°$. Using this photometry we have been conducting a systematic survey for new rapidly oscillating Ap (roAp) stars. In this note we announce the 12th one found as part of the survey, the 27th now known.

HD 86181 was classified as Ap Sr by Houk & Cowley (1975). Martinez (1993) measured $V=9.323$, $b-y=0.172$, $m_1=0.205$, $c_1=0.757$ and $\beta=2.819$. The calculated dereddened metallicity and luminosity indices are $[\delta m_1]=-0.030$ and $[\delta c_1]=-0.095$, both of which indicate strong metallicity and heavy line-blocking in the Strömgren v band, characteristics we have come to associate with roAp stars.

On the night of 11/12 March 1994 we obtained 4.85 hours of continuous 10-s photometric integrations of HD 86181 through a Johnson B filter using the 0.5-m telescope of the Sutherland Station of the South African Astronomical Observatory. The observations were corrected for coincidence losses, sky brightness, extinction and reduced to 40-s integrations. Figure 1 shows a two-hour section of the light curve for that night and Figure 2 shows the amplitude spectrum of the entire 4.85-hr light curve. The 6.2-min oscillations are obvious in both. No comparison star was used, but sky trancparency variations, scintillation, and photon statistics produced noise of a maximum amplitude of about 0.35 mmag at the frequencies of interest, as can be seen in the amplitude spectrum.

We are continuing observations of this star and, as of this writing, have 24 hours of observations obtained on 6 nights. The amplitude of the light curve is modulated. The star is multiperiodic and may also show rotational amplitude modulation.

Figure 1

HD86181 JD2449423 B 40
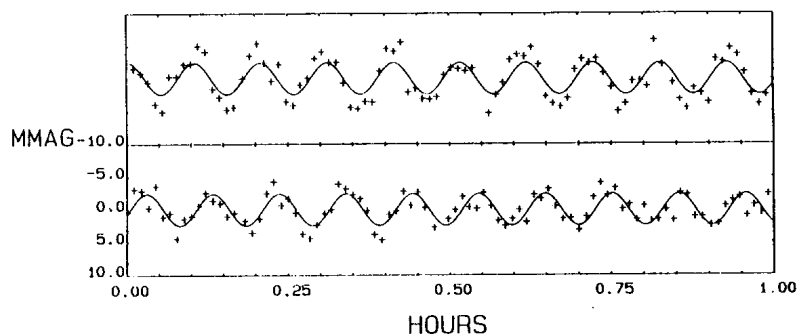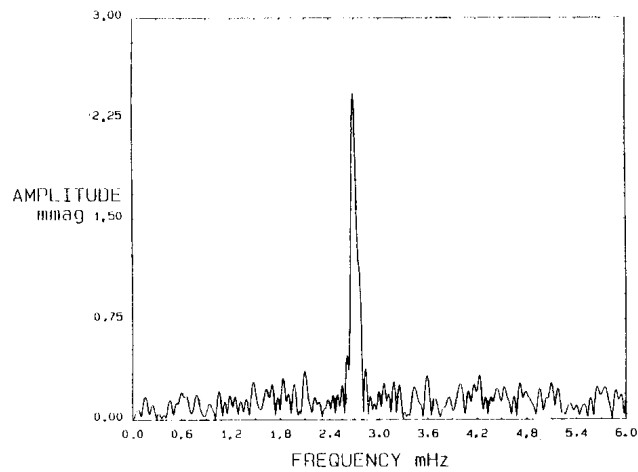
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TRANSIENT PERIOD FOUND IN THE BY DRA VARIABLE OU GEMINORUM

Results from Mt Cuba Astronomical Observatory

A transient period of 46 seconds was found in ultraviolet monitoring of the BY Dra variable OU Geminorum (Gliese 233, HD 45088), using the methods described by Andrews (1990).

Our flare star monitoring system comprises a 61-centimeter reflecting telescope, a Hamamatsu HC124-03 photomultiplier (spectral range 300-650 nm), and a Keithley MetraByte CTM-05 pulse counter. All observations of OU Gem were made through a Johnson U filter, though not reduced to the U system. A total of 10.2 hours have been accumulated on OU Gem; in addition, several stars have been observed as comparisons, primarily BD+18°1212. A comprehensive journal of the OU Gem observations is found in Table 1. The data are analyzed by modified autocorrelation and discrete Fourier transform (MAC+DFT), to look for periodic behavior in the light curve. This procedure has been used by us in previous studies (Mullan et al, 1992). The data of 94feb17, 94mar13, and the last ten minutes of 94feb15 are corrupted by some cirrus clouds; these data are not useful for period searches, but can be used to look for flares. No obvious flares have been detected; however, a period has been found on the exceptionally photometric night of 94feb04.

The sequence of observations on 94feb04 is listed in Table 2. OU Gem and Gliese 169 were observed as flare star candidates; the other two stars were used as comparisons. What concerns us in this bulletin is the detection of a transient period in the first half of the ninety-minute data set. With the MAC+.DFT we have found a period of 46 seconds that appears to be strongest in the segment from t=900 to 2250 seconds (see periodogram in Figure 1). For subsets earlier in the data set, the power in the 46-second periodogram peak is diminished significantly, and for subsets toward the end of the run the peak disappears entirely. No periodicity was found in any of the other star data sets, including the later OU Gem run. To test the statistical significance of the detection, we implemented the randomization technique described in Mullan et al; the result of this procedure was multiplied by a factor derived from the probability distribution of the frequencies in the randomly generated power spectra (McKenzie, 1993). The result is a two-dimensional Chance Probability of $P_c^{2D} = 0.87\%$; that is, the detection is considered to be 99.1% reliable. This period (46 sec) lies comfortably within the range expected for Ionson-Mullan magnetic wave resonance. In fact, for a period of 46 seconds Andrews (1989) suggests an X-ray flux of log $F_X = 6.66$, remarkably close to the value of 6.61 found by Panagi and Mathioudakis

Table 1. **Journal of OU Gem Observations.** The mean signal level (μ) and the standard deviation (σ) for the star are in counts per second and have had the sky and dark counts subtracted.

Date	UT Start Time	Length	μ	σ
94feb04	01:13:01	90 min	29850	0651
	05:33:21	60 min	21140	1527
94feb15	01:34:21	90 min	26805	0959
	04:01:01	81 min	18708	2287 (clouds)
94feb17	02:47:11	90 min	24585	1933 (clouds)
94mar12	00:34:01	90 min	27107	0861
	03:22:16	30 min	20516	0944
94mar13	00:27:41	90 min	24362	1608 (clouds)

Table 2. **Journal of 94Feb04.** The mean signal level is as in Table 1. Mean dark count for this night was 45 counts/sec and sky was 2095 counts/sec.

Star	UT Start Time	Length	μ	σ
OU Gem	01:13:01	90 min	29850	0651
Gliese 169	03:53:01	30 min	01889	0190
BD+21°650	04:33:46	30 min	02294	0216
OU Gem	05:33:21	60 min	21140	1527
BD+18°1212	06:46:21	12 min	05612	0294
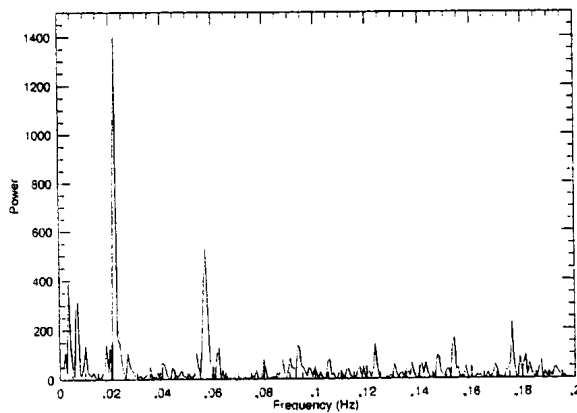
Figure 1. Periodogram of OU Gem, 94Feb04.
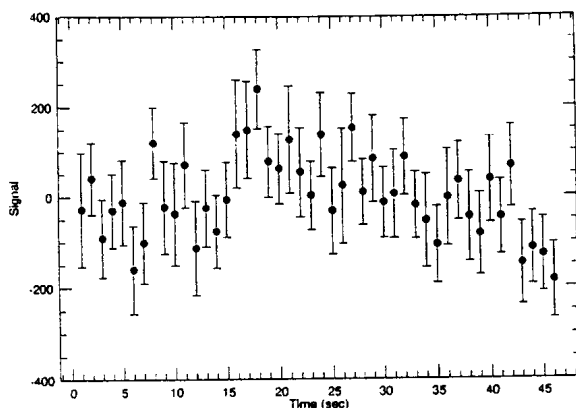
Figure 2. Average Profile of 46-sec Oscillation.

(1993) for OU Gem. That the apparent duration of the oscillation is less than 30 cycles is also consistent with the Ionson-Mullan theory. To reveal the profile of the oscillation, we have folded this segment of the data set (t = 900-2250 sec) at a period of 46 seconds. The coaddition routine is very straightforward: the data stream is divided into 29 subsets, each 46 seconds in length. These subsets are then averaged point-by-point. The resulting average profile is shown (with standard deviation errorbars) in Figure 2. It is noted that the (average) amplitude is approximately 0.38 times the standard deviation of the raw data, consistent with the findings of Mullan et al regarding the sensitivity of the MAC+DFT analysis routine. We are currently exploring alternative techniques for period searching, for the purpose of comparison with the MAC+DFT used to detect this period.

The authors are pleased to acknowledge Matt Templeton, Dan Smith, Jack Fisher, and Jeff Frank for their assistance in making the observations. We are also grateful to the trustees of Mount Cuba Astronomical Observatory for many hours of observing time.

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EP And = NSV 598

During my work on *PICA project* (Precise Identification and Coordinate Adjust-
ment of about 7000 variables) I have found that *EP And* is identical with *NSV 598*.

EP And = BV 75 was discovered by Strohmeier et al. (1955). In his paper the
type of variability is commented as "slow changes". Eclipsing nature was first found
by Filatov (1960), but he gave incorrect elements. This star has received its final
designation in 1967 (Kukarkin et al., 1967). In 1975 (Diethelm, Locher, 1975) first
visual observations by BBSAG appeared giving in short time the first correct elements
for this W-UMa type star (Locher, 1976). From 1975 it was many times observed
either visually or by photoelectric means and also on plates of photographic archives.

NSV 598 = Brun 16 was discovered by Brun (1963). His comment to the star
is short, stating only "No 662 in Bergedorfer Spektral Durchmusterung. Mag: 11.74
Sp. F8. Maxima are frequent". Fortunately finder chart was published in the paper.
I have found no other paper concerning this star. No final designation was accepted
for this star and it was included into New Catalogue of Suspected Variable Stars
(Kholopov et al., 1982).

Figure 1: Finding chart for EP And = NSV 598. The chart covers about 60' x 45'
with north up. Variable is marked with two short lines.

Name	Position (B1950)		Position (J2000)		Type	Max mag	Min mag	Ph. s.
	h m s	° '	h m s	° ' "				
NSV 598	01 39 31	+44 30.8	01 42 33	+44 45.9		11.7	12.5	p
EP And	01 39 28	+44 30.6	01 42 30	+44 45.7	EW	11.9	12.5	p
EP And (Plaut)	01 39 27.65	+44 30 36.8	01 42 29.54	+44 45 42.9		11.9	12.5	p
GSC 2827.0017	01 39 27.48	+44 30 36.8	01 42 29.37	+44 45 42.9		11.74		1

Table 1: Comparative table of *original* data for NSV 598, GSC 2827.0017 and EP And. Data concerning NSV 598 are from NSV, data for EP And are from GCVS, for EP And (Plaut) are by Plaut (1977) and data for GSC 2827.0017 are from GSC. Photometric system code 1 for GSC represents the Kodak IIa-D plate with W12 filter. Coordinates printed in italics were computed from the above stated data sources.

While working on field variable stars around *EP And* I have noticed that *NSV 598* lies quite close to *EP And*. As I wasn't successful in obtaining the original chart of Strohmeier et al. (1955) for *EP And*, I had to use the chart of Berthold (1982) to be sure. Berthold's chart refers to the same star as Brun's chart. Additional check has confirmed this. As *EP And* is identical with GSC 2827.0017 the J2000.0 coordinates were easily found (see Table 1). These coordinates are consistent with those given by Plaut (1977). The remaining difference may have origin in proper motion, as the epoch differs by 90 years. Finding chart (see Figure 1) was adapted from Atlas Stellarum (Vehrenberg, 1970).

Following cross-identifications are valid : EP And = BV 75 = Brun 16 = NSV 598 = Hels ph $1^h40^m + 44°$ N°93 = Hels ph $1^h35^m + 45°$ N°385 = GSC 2827.0017

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EK Lac = NSV 14025

During my work on *PICA project* (Precise Identification and Coordinate Adjustment of about 7000 variables) I have found that *EK Lac* is identical with *NSV 14025*.

EK Lac = SVS 1114 was discovered by Kurochkin in 1949 (Kukarkin, 1952). Kukarkin (1952) has investigated this star and gave the light elements and finding chart for this eclipsing binary. The star has received its final designation in 1952 (Kukarkin et al., 1952). From that time only times of three individual minima have been secured.

NSV 14025 = Brun 29 was discovered by Brun (1964), giving also the finding chart. No final designation was accepted for this star and it was included into New Catalogue of Suspected Variable Stars (Kholopov et al., 1982).

While working on field variable stars around *EK Lac* I have noticed that chart referring to *NSV 14025* in fact refers to *EK Lac*, although the stated coordinates are about 7' off the *EK Lac* position. While checking the literature it became clear that Brun has overlooked in 1964 the identity of his star with *EK Lac*, already named 12 years earlier. This identity was overlooked also by compilers of NSV. As finding charts are available for both stars, their identity is clear.

As *EK Lac* is identical with GSC 3613.1331 the J2000.0 coordinates were easily found (see Table 1). These coordinates are consistent with those given by Plaut (1977). The remaining difference may have origin in proper motion, as the epoch differs by 81 years. Finding chart (see Figure 1) was adapted from Atlas Stellarum (Vehrenberg, 1970).
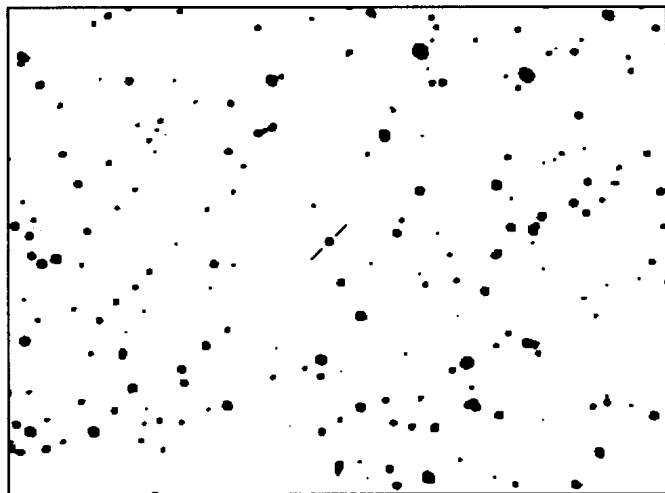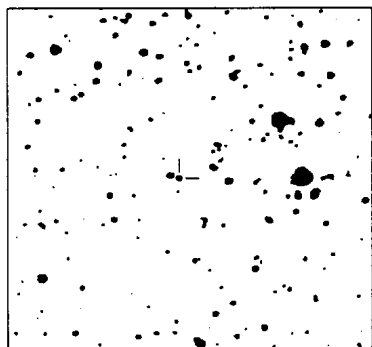

Figure 1: Finding chart for EK Lac = NSV 14025. The chart covers about 40' x 35' with north up. Variable is marked with two short lines.

Name	Position (B1950)		Position (J2000)		Type	Max	Min	Ph.
	h m s	° '	h m s	° ' "		mag	mag	s.
NSV 14025	22 03 36	+49 24.4	*22 05 32*	*+49 39.0*	EA:	10.8	11.3	p
EK Lac	22 02 54	+49 25.6	*22 04 50*	*+49 40.2*	EA	11.2	11.7	p
EK Lac (Plaut)	22 02 53.95	+49 25 34.6	*22 04 49.72*	*+49 40 10.6*				
GSC 3613.1331	*22 02 54.03*	*+49 25 35.3*	22 04 49.80	+49 40 11.2		11.17		1

Table 1: Comparative table of *original* data for NSV 14025, GSC 3613.1331 and EK Lac. Data concerning NSV 14025 are from NSV, data for EK Lac are from GCVS, for EK Lac (Plaut) are by Plaut (1977) and data for GSC 3613.1331 are from GSC. Photometric system code 1 for GSC represents the Kodak IIa-D plate with W12 filter. Coordinates printed in italics were computed from the above stated data sources.

In cross-reference tables of NSV catalogue *NSV 14025* is stated to be identical with BD +48°3603. Regrettably this identification, based on the coordinates reported by Brun, is not valid. This BD star, according to Brun's chart, is the star 1' NE with respect to the variable, but this is incorrect too, because BD +48°3603 is in fact about 7' E-SE from *EK Lac*. The BD star nearest to *EK Lac* is BD +48°3599, located 1.7' north of variable, but no bright star can be found in this place. It is a question, whether BD +48°3599 should be identified with *EK Lac* or its only slighly brighter neighbour, because they are both at the same distance from the reported position of BD +48°3599.

Following cross-identifications are valid : EK Lac = GSC 3613.1331 = SVS 1114 = Brun 29 = Cat ph $22^h06^m + 49°$ N°108 = Cat ph $22^h00^m + 50°$ N°529 = NSV 14025

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IX And = NSV 372

During my work on *PICA project* (Precise Identification and Coordinate Adjustment of about 7000 variables) I have found that *IX And* is identical with *NSV 372*.

IX And = P 2495 = DO 8612(M4) = CSV 100080 = S 9500 was suspected to be variable by Nijland (1936). Variability of this star was independently rediscovered by Hoffmeister (1966) and a finding chart was also published (Hoffmeister, 1967). Additional information has appeared in 1975 (Meinunger, 1975). The star has received its final designation in 1977 (Kukarkin et al., 1977).

NSV 372 = CSV 100082 was suspected to be variable by Martynov (1938) being used as comparison *t for WZ And. No final designation was accepted for this star and it was included into Catalogue of Suspected Variable stars (Kukarkin et al., 1951). Meinunger (1975) has investigated this star and found it to be constant (as we will see later he was in fact estimating comp.*p of Martynov (1938) which is constant). Later it was also included in the New Catalogue of Suspected Variable Stars (Kholopov et al., 1982). In both catalogues this star is believed to be non-variable. According to NSV no chart was published for this star (and for nearby *NSV 371* = comp.*n too).

While working on field variable stars around *WZ And* I have noticed that on the chart recommended for WZ And by GCVS (Martynov, 1938) are also marked all used comparison stars, including *t. I was amazed because *t, according to coordinates, should be on different place. When comparing data in Table 3 (page 13) of Martynov (giving the relative coordinates and magnitudes of all comparison stars) to the chart,
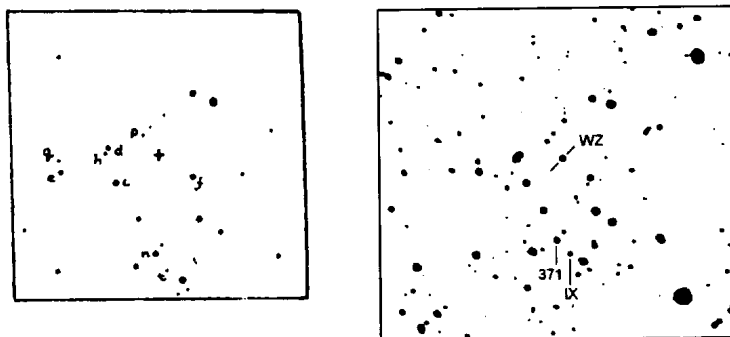
Figure 1: Left: the finding chart for WZ And (cross) with comparison stars used by Martynov (1938). Right: the same region adapted from Atlas Stellarum (Vehrenberg, 1970) covering about 45' x 40' with north up. The variables WZ And, NSV 371 (comp.*n) and IX And=NSV 372 (comp.*t) are marked on this chart.

Name	Position (B1950)		Position (J2000)		Type	Max	Min	Phot.
	h m s	° '	h m s	° ' "		mag	mag	system
NSV 372	00 59 03	+37 52.1	*01 01 50*	*+38 08.2*	–	11.7		p
IX And	00 58 50	+37 38.0	*01 01 37*	*+37 54.1*	Lb	12.9	14.2	p
GSC 2799.1599	*00 58 53.36*	*+37 37 39.1*	01 01 40.58	+37 53 46.5		10.89		1

Table 1: Comparative table of *original* data for NSV 372, GSC 2799.1599 and IX And. Data concerning NSV 372 are from NSV, data for IX And are from GCVS and data for GSC 2799.1599 are from GSC. Photometric system code 1 for GSC represents the Kodak IIa-D plate with W12 filter. Coordinates printed in italics were computed from the above stated data sources.

I have found that comp. *p and *t are interchanged. But which source is correct ? The table or the chart ? Fortunately from Table 2 (page 13) of Martynov (giving data on linking comp. stars to photometric standards) is evident that the chart is correct and the error is in Table 3 – the line with relative coordinates and final magnitude, in the first column stating to refer to *p refers in fact to *t and vice versa. When this was clear it was easy to identify *NSV 372* as *IX And*.

The reported coordinates for *IX And* were found to be somewhat off the star's real position. As this star is identical with GSC 2799.1599 the correct coordinates were easily found (see Table 1). Finding chart (see Figure 1) was adapted from Atlas Stellarum (Vehrenberg, 1970).

Following cross-identifications are valid : IX And = P 2495 = DO 8612(M4) = CSV 100080 = CSV 100082 = S 9500 = NSV 372.

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TIMES OF MINIMUM OF ECLIPSING BINARIES

IN AND NEAR CENTAURUS

In 1982 and again in 1989 photometric light curves were obtained at Mt. John University Observatory in New Zealand for a close group of eclipsing binaries in and near the constellation of Centaurus. All data were obtained with the single channel photoelectric photometer on the 0.6 meter photoelectric telescope using the observatory's *uvby* filter set. During the course of these observations many primary and secondary minima were observed. The times of minimum determined from the observations are presented in Table I.

Table I. Determinations of Times of Minimum

STAR	HJD 2440000+	S.E.	MINIMUM
MP CEN	5049.090	0.006	II
	5064.052	0.003	II
	5093.989	0.007	II
	7609.993	0.001	I
	7624.955	0.001	I
	7627.948	0.001	I
MR CEN	7610.974	0.003	I
VZ CEN	7628.138	0.005	I
BF CEN	5064.953	0.008	II
	5087.100	0.009	II
	7628.128	0.005	II
	7665.064	0.002	II
LZ CEN	5064.007	0.007	I
	5086.072	0.012	I
	5088.816	0.010	I
	5092.965	0.006	II
	7612.142	0.003	I
LT CEN	5068.929	0.001	I
	5085.142	0.004	I
	5094.122	0.001	II
	7611.040	0.001	II
	7615.110	0.001	I
	7628.121	0.001	I
MN CEN	5049.104	0.009	II
	5084.004	0.004	II
	7611.897	0.003	I
AE CRU	5049.043	0.001	I

2

For each minimum in Table I the Heliocentric Julian Date listed is the average time of minimum for all four filters. The accompanying standard errors were determined using the time residuals of each filter from this average.

In planning the observing program for these stars the light elements from the Finding List of Wood et al. (1980) were used. The times of minimum in Table I are generally not close to the times predicted from these light elements. In most cases the epochs rather than the periods seemed to be at fault, since the O-C values for most of the stars were about the same in 1982 and 1989. However, we note that, in particular, the period for LT Cen appears to be longer than that given in the Finding List.

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Wood, F.B., Oliver, J.P., Florkowski, D.R., and Koch, R.H., 1980, *A Finding List for Observers of Interacting Binary Stars*

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OBSERVATIONS OF A SYMBIOTIC NOVA IN SAGITTARIUS

This object was discovered by Minoru Wakuda on March 14, 1994, as a star of 10^m7 and announced as a peculiar variable (Hirayama 1994). The position is $\alpha = 18^h51^m43^s$, $\delta = -19°45'9$ (1950.0). The star has already been bright since 1993 March 29, but was fainter than 12^m5 throughout 1992.

Spectroscopic observations were carried out on 1994 March 30.4 (UT) with the ESO/MPI 2.2m-telescope and EFOSC-II. A low resolution spectrum (Fig. 1, resolution 0.84 nm) shows emission lines of Hα, Hβ and the infrared Ca II triplet, superimposed on a somewhat veiled late-K-giant continuum. A high-resolution spectrum (Fig. 2, resolution 0.19 nm) shows the Ca II H and K lines in absorption, as well as narrow emission lines of Hβ and Fe II.

The absence of blueshifted absorption lines, the narrowness of the emission lines (FWHM < 250 km s^{-1}), as well as the long standstill at maximum magnitude excludes the classification as a classical nova. The blue emission line spectrum resembles that of the symbiotic nova PU Vul in 1987–1988, eight years after brightness rise (Iijima 1989).

On 21 plates of the Sonneberg astrograph 400/1600 mm, taken between 1984 and 1988, as well as on the last available sky patrol plate of this area, taken in 1990, the object is invisible. The data are as follows:

JD 244...	m_{pg}	JD 244...	m_{pg}	JD 244...	m_{pg}	JD 244...	m_{pg}
5912.43	[16.5	7039.32	[15.5	7088.24	[16.5	7387.39	[17
6232.52	[16.5	7039.33	[15.5	7088.25	[16.5	7404.32	[17
6264.46	[15	7063.30	[16.5	7353.43	[16.5	7404.33	[17
6287.38	[17	7063.31	[16.5	7353.44	[17	8069.49	[12
6287.39	[16.5	7087.24	[16.5	7355.34	[17		
6298.39	[16.5	7087.25	[16.5	7387.38	[17		

On 667 additional plates of the Sonneberg sky patrol with plate limits of about 12...14, taken in 1926...1948 and 1950...1983, the object is also always invisible. Similar results, based on 272 Harvard plates for the interval 1888...1989, are reported by Hazen (1994).

A direct CCD frame taken at outburst (Fig. 3) was compared with the ESO/SERC Atlas J and R film copies. The outburst image lies in an empty field, $\approx 3''$ north of the connecting line of two stars of about 20^m, whose separation is $\approx 5''$. Thus the preoutburst magnitude was below the limit of both plates, i.e. below $m_V \approx 21.5$, indicating an outburst amplitude of more than 11^m. This is unusually large for a symbiotic nova; until now the poorly known object V2110 Oph = AS 239 held the record with 8^m, while RR Tel has an amplitude of about 7^m5 (Allen 1978, 1984; Duerbeck 1987).
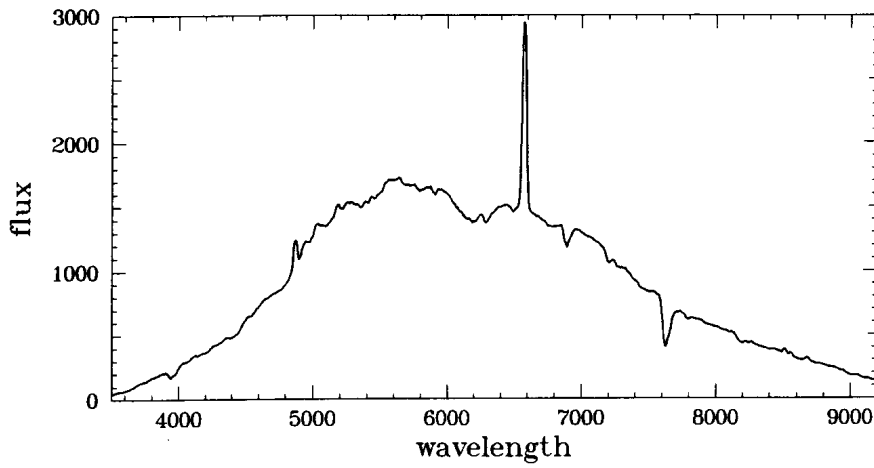
Figure 1. Low-resolution spectrum of the symbiotic nova, taken 1994 March 30.4 with EFOSC-II and grism 1 at the ESO/MPI 2.2m-telescope. Besides Hα and Hβ, the infrared Ca II triplet at 8498, 8542 and 8662 Å is present as weak emission, while the Ca II H+K lines appear in absorption. The features in the continuum mimic a late K giant spectrum, but show low contrast, possibly being veiled by a featureless continuum.
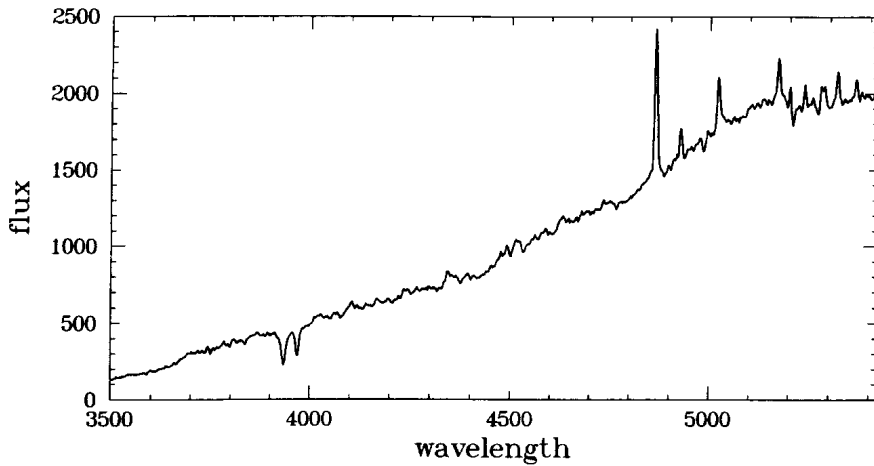
Figure 2. Medium-resolution blue spectrum of the symbiotic nova, taken 1994 March 30.4 with EFOSC-II and grism 3 at the ESO/MPI 2.2m-telescope. The Ca II H+K lines appear in absorption. Hβ is seen in emission. The lines at 4925, 5021, 5171, 5199, 5235, 5282, 5315 and 5365 Å belong to the Fe II multiplets 41, 42, 48 and 49.
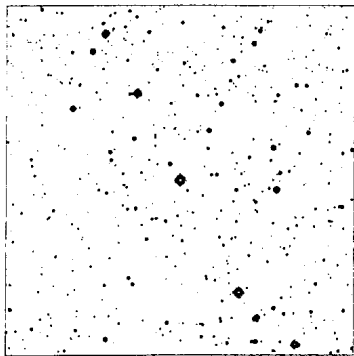
Figure 3. The field of Wakuda's symbiotic nova, observed 1994 March 30.4 with EFOSC-II at the ESO/MPI 2.2m-telescope. The field is 4!3 × 4!3, and the object is the bright star at the center. North is on the top, east to the left.

With galactic coordinates $\ell = 15°56, b = -9°53$, the variable lies in field No. 158 of Neckel's (1967) survey of galactic absorption, where A_V at large distances is typically 1^m. Assuming Eddington luminosity for a medium mass white dwarf at outburst, $M_V \approx 6$ (Kenyon and Truran 1983), its distance is about 10 kpc, and with a z-distance of 1700 pc, it appears to be a bulge object. There is one caveat, however: The absolute magnitude of its progenitor, M_V, is fainter than 5m, and excludes any late type giant companion. Assuming an M-type giant companion would lead to unusually large distances and outburst luminosities.

A ROSAT pointed observation carried out on 1992 Oct. 13/14 includes the field of the variable. No X-ray source was found, giving an upper limit of 0.004 cts/s. Assuming a 10^7 K blackbody emission (resp., bremsstrahlung spectrum) with $A_V = 1$, this corresponds to $4 \cdot 10^{-13}$ erg cm^{-2} s^{-1} and $8 \cdot 10^{-14}$ erg cm^{-2} s^{-1}, respectively.

Monitoring of the ongoing outburst is encouraged.

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POSITIONS OF VARIABLE STARS IN PLAUT'S FIELD 1

In the course of the Palomar–Groningen variable star survey, the late Prof. L. Plaut discovered several thousand variable stars in Baade windows. His record is the world-second by number of variables discovered by a single person, after C. Hoffmeister. Prof. Plaut's results were ultimately used for the well-known study of the spatial distribution of RR Lyrae stars in the central region of our Galaxy (Oort and Plaut, 1975). The majority of variables discovered by Plaut remain studied only by him. One of the reasons for this is that finding charts were not published for these stars. In the seventies, Prof. Plaut very courteously sent photographic charts of variable stars discovered by him to the compilers of the General Catalogue of Variable Stars. So we have a unique possibility to check positions and possible identifications of these stars and to provide the astronomical community with information necessary to find these objects in the sky.

The present paper deals with the variable stars in the Palomar–Groningen Field 1 (Plaut, 1966). 77 variables were discovered in the field, 12 of them being rediscoveries. We have compared the finding charts for all of them with corresponding fields of the Hubble Space Telescope Guide Star Catalog. For this purpose, sky regions from the GSC catalog were visualized on a computer display. 30 stars have been identified with the GSC, the results are presented in Table 1. The columns of this Table are self-explanatory. Table 1 also contains GSC identifications for five GCVS stars discovered not by Plaut. These stars are indicated by an asterisk in the last column. Plaut's star No. 32 (V771 Sco) appears double on Plaut's charts, we present co-ordinates for the brighter component. GSC co-ordinates for the star No. 45 (V784 Sco) differ noticeably (by $0\overset{s}{.}5$) from those given by Plaut.

For those stars not present in the GSC, we have checked the agreement of their positions in the finding charts with co-ordinates published by Plaut or given in the GCVS. In most cases the agreement is very good. The position of No. 57 (V797 Sco) in Plaut (1966) is wrong by 1° in declination, its correct co-ordinates must be $16^h09^m01^s$, $-14°52\overset{'}{.}7$ (1950.0); this agrees with the star's schematic position in Fig. 4 in Plaut (1966). Other noticeable discrepancies have been found only in 3 cases presented in Table 2. The co-ordinates in this Table have been measured by us relative to neighboring GSC stars. The GCVS position for No. 8 (EX Lib) was given according to Hanley (1942); our present position agrees better with Plaut (1966). The GCVS position for No. 56 (V798 Sco) rests upon corrected co-ordinates communicated by Plaut to the compilers; the co-ordinates found by us differ considerably from the co-ordinates in Plaut (1966) and from the GCVS co-ordinates.

Table 1

No. Plaut	GCVS	α_{2000}	δ_{2000}	GSC	
2	EU Lib	$15^h54^m08\overset{s}{.}7$	$-10°50'36"$	5614-0851	
	GP Lib	15 54 29.2	-10 52 30	5614-0765	*
3	DT Lib	15 54 36.8	-11 11 28	5614-0609	
5	DU Lib	15 55 14.0	-13 19 06	5622-1303	
7	SW Lib	15 55 33.4	-12 51 04	5618-0788	
12	FG Lib	15 56 58.7	-14 28 27	5622-1480	
	DW Lib	15 57 30.7	-14 04 50	5623-0863	*
14	FI Lib	15 57 42.8	-14 44 11	5623-0382	
	DX Lib	15 58 38.2	-13 40 25	5623-1017	*
16	FL Lib	15 58 40.4	-11 19 52	5619-1223	
18	UV Lib	15 59 10.7	-14 10 55	5623-0576	
24	FR Lib	16 00 15.9	-14 21 41	5623-0740	
25	FS Lib	16 00 23.7	-12 20 58	5619-0068	
26	FT Lib	16 00 52.1	-13 07 10	5619-0545	
27	FU Lib	16 01 00.9	-09 26 36	5615-0235	
28	V767 Sco	16 03 20.8	-10 30 11	5615-0464	
29	V768 Sco	16 03 25.9	-13 19 31	5623-1134	
31	V770 Sco	16 03 44.2	-13 06 49	5619-0373	
32	V771 Sco	16 03 51.6	-13 10 32	5623-0577	
33	V772 Sco	16 03 53.7	-12 27 54	5619-0172	
40	V779 Sco	16 06 25.1	-14 34 40	5624-1376	
44	V783 Sco	16 08 36.4	-12 06 28	5620-0573	
45	V784 Sco	16 08 48.9	-14 38 45	5624-0978	
49	V790 Sco	16 09 48.5	-14 37 16	5624-0608	
54	V795 Sco	16 11 21.5	-13 55 49	5624-0343	
58	V799 Sco	16 12 31.1	-14 42 03	5624-1026	
60	V801 Sco	16 12 53.6	-12 09 44	5621-0363	
	V854 Sco	16 13 15.7	-09 53 24	5617-0730	*
61	V802 Sco	16 13 19.7	-13 31 36	5625-0196	
65	V806 Sco	16 14 43.7	-10 42 53	5617-0524	
	KU Sco	16 15 01.3	-13 45 53	5625-0887	*
66	V559 Sco	16 15 04.0	-09 47 07	5617-0938	
72	V812 Sco	16 15 57.9	-14 43 08	5625-0974	
74	V814 Sco	16 16 19.1	-12 47 12	5621-0146	
77	V817 Sco	16 18 13.2	-12 56 21	5621-0063	

3

Table 2

No. Plaut	GCVS	α_{2000}	δ_{2000}
8	EX Lib	$15^h54^m41\!.\!0$	$-12°47'34"$
56	V798 Sco	16 04 07.5	-12 59 30
48	V789 Sco	16 10 02.4	-12 18 01

We appeal to Dutch researchers having access to the material used by Prof. Plaut to check the problems raised in our publication.

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POSITIONS OF VARIABLE STARS IN PLAUT'S FIELD 2

This paper continues the study announced in our previous publication (Antipin et al., 1994) and deals with the variable stars in the Palomar–Groningen Field 2 (Plaut, 1968). 924 variables were discovered by Plaut in the field, 46 of them being rediscoveries. We have compared the finding charts for all of them with corresponding fields of the HST Guide Star Catalog. 67 stars have been identified with the GSC, the results are presented in Table 1. Remarks to the Table are given for stars with the symbol "R" in the last column. Table 1 contains also GSC identifications for 5 GCVS or NSV stars in the field discovered not by Plaut; these stars are indicated by asterisks in the last column.

For those stars not present in the GSC, we have checked the agreement of their positions in the finding charts with co-ordinates published by Plaut. In most cases the agreement is very good. Noticeable discrepancies have been found only in 8 cases presented in Table 2.

Table 1

No. Plaut	GCVS NSV	α_{2000}	δ_{2000}	GSC	Remark
4	V1128 Oph	$16^h56^m51\!.^s6$	$-20°06'42"$	6227-2446	
6	V1133 Oph	16 56 59.3	$-17\ 53\ 15$	6223-1364	
9	V1135 Oph	16 57 03.6	$-18\ 29\ 21$	6223-1724	
21	V1145 Oph	16 57 40.0	$-21\ 19\ 40$	6231-2187	
30	V1154 Oph	16 58 23.0	$-20\ 01\ 47$	6227-1599	
32	V1157 Oph	16 58 28.9	$-17\ 29\ 47$	6223-0235	
33	V1158 Oph	16 58 33.3	$-18\ 38\ 02$	6223-1616	
44	V1169 Oph	16 59 08.8	$-18\ 40\ 54$	6223-1043	
45	V1171 Oph	16 59 15.6	$-18\ 12\ 44$	6223-1299	
53	V1182 Oph	16 59 25.5	$-16\ 30\ 41$	6219-0888	R
59	NSV 8086	16 59 38.3	$-19\ 56\ 50$	6227-2832	
62	V1187 Oph	17 00 01.6	$-20\ 56\ 49$	6231-0216	
66	V1190 Oph	17 00 06.4	$-21\ 00\ 28$	6231-1254	
	NSV 8094	17 00 07.1	$-18\ 04\ 56$	6223-0374	*
67	V1191 Oph	17 00 10.0	$-21\ 01\ 09$	6231-0033	
75	V1199 Oph	17 00 29.6	$-20\ 30\ 50$	6227-0263	R
79	V1206 Oph	17 00 34.5	$-17\ 10\ 18$	6223-1315	
80	V1203 Oph	17 00 40.3	$-21\ 21\ 20$	6231-2425	
102	V1227 Oph	17 01 22.8	$-17\ 09\ 36$	6223-1009	

Table 1 (continued)

No. Plaut	GCVS NSV	α_{2000}	δ_{2000}	GSC	Remark
120	V1245 Oph	$17^h02^m06\overset{s}{.}4$	$-18°52'51"$	6227-1006	
151	V1275 Oph	17 03 01.2	−19 10 37	6227-1510	
154	V1277 Oph	17 03 16.7	−21 18 53	6231-2410	
158	V1281 Oph	17 03 26.1	−21 48 19	6231-2432	
177	V1301 Oph	17 04 16.4	−18 46 27	6240-0817	
190	V1316 Oph	17 04 42.7	−16 59 58	6236-0400	
201	NSV 8166	17 05 05.0	−22 01 08	6244-0021	
230	V1353 Oph	17 06 00.6	−21 57 41	6244-0168	
248	V1373 Oph	17 06 31.6	−18 05 19	6236-0370	
258	V1381 Oph	17 06 42.6	−16 52 11	6232-1017	
269	V1392 Oph	17 07 05.5	−20 35 14	6240-0819	
298	V1421 Oph	17 07 56.5	−18 48 40	6240-0862	
305	V1427 Oph	17 08 07.8	−20 57 06	6244-0134	R
306	V1428 Oph	17 08 12.6	−22 16 55	6244-0024	R
331	V1451 Oph	17 08 57.1	−21 37 14	6244-0578	
344	V1468 Oph	17 09 14.7	−17 37 46	6236-1084	
359	V1481 Oph	17 09 37.5	−20 01 01	6240-0551	
383	V1503 Oph	17 10 15.0	−19 06 07	6240-0743	
401	V1524 Oph	17 10 38.2	−17 17 27	6236-0303	
415	NSV 8261	17 11 02.4	−16 56 37	6236-0320	
423	V1543 Oph	17 11 18.0	−16 56 52	6236-1140	R
442	V1559 Oph	17 11 52.6	−19 16 12	6240-0349	
461	V1577 Oph	17 12 12.9	−20 01 28	6241-0757	
485	V1602 Oph	17 12 41.7	−17 38 15	6237-0491	
507	V1623 Oph	17 13 09.0	−18 21 08	6237-0425	R
509	V1625 Oph	17 13 20.2	−19 14 27	6241-0841	
520	V1637 Oph	17 13 35.1	−18 05 50	6237-2975	
525	V1645 Oph	17 13 41.3	−16 35 55	6233-0832	R
543	V1658 Oph	17 14 11.8	−20 55 02	6245-0363	
	V448 Oph	17 15 20.8	−18 07 02	6237-1702	*R
587	V1699 Oph	17 15 23.0	−21 26 18	6245-0456	
616	V1733 Oph	17 16 13.2	−17 19 41	6237-2794	R
652	V1764 Oph	17 16 57.8	−17 18 14	6237-2842	
662	V1774 Oph	17 17 16.3	−17 30 44	6237-0492	
677	V2071 Oph	17 17 31.9	−17 52 54	6237-1380	
688	AE Oph	17 17 52.6	−20 01 19	6241-0297	
	NSV 8465	17 17 58.9	−18 06 04	6237-1123	*
705	V1814 Oph	17 18 06.3	−16 58 40	6237-0935	
703	V1810 Oph	17 18 06.4	−18 54 06	6241-0378	
	NSV 8472	17 18 10.0	−17 15 48	6237-0573	*
718	V1828 Oph	17 18 33.0	−16 45 05	6233-0932	
724	NSV 8486	17 18 44.6	−18 56 15	6241-0062	
769	V1872 Oph	17 19 51.4	−18 49 33	6241-0286	

Table 1 (continued)

No. Plaut	GCVS NSV	α_{2000}	δ_{2000}	GSC	Remark
773	V742 Oph	$17^{h}19^{m}56\overset{s}{.}5$	$-18°54'11"$	6241-0885	
778	V1878 Oph	17 20 02.7	$-21\ 35\ 24$	6246-0162	
815	V441 Oph	17 20 52.8	$-17\ 20\ 05$	6238-1066	
	NSV 8540	17 20 55.0	$-21\ 29\ 20$	6246-0428	*
830	V1930 Oph	17 21 14.1	$-16\ 27\ 50$	6234-0986	
851	V1950 Oph	17 21 39.9	$-18\ 56\ 57$	6242-0035	R
872	V1972 Oph	17 22 15.0	$-18\ 21\ 06$	6238-0396	
873	V1970 Oph	17 22 23.7	$-22\ 30\ 56$	6825-0189	
878	V1978 Oph	17 22 30.1	$-17\ 34\ 31$	6238-2620	
898	V1999 Oph	17 22 56.1	$-17\ 14\ 05$	6238-1136	

Remarks. V1182 Oph. Double; the GSC star is the red, brighter, following component that presumably varies. V1199 Oph. Double; the GSC star is the redder, brighter, preceding component that presumably varies. V1427 Oph. Close double. The finding chart presumably shows the northwestern component to be variable; the southeastern component seems redder on Palomar prints. It is not clear which of the components is present in the GSC. V1428 Oph. Possibly multiple. The GSC star is, most probably, the brightest and the reddest component which varies. V1543 Oph. Multiple; the brightest component enters the GSC. V1623 Oph. Double; the brighter component enters the GSC. V1645 Oph. Double; the northwestern component marked by Plaut as variable. We are not sure which component is in GSC, but maybe the southeastern one. V448 Oph (SVS 431). The finding chart (Shajn, 1934) is rather bad, and the published position is wrong by 1° in declination. Our identification with GSC refers to a star actually found by us to be variable on Moscow plates. The mistake in the published position was originally communicated to us by A. Paschke (Zürich), but he apparently identified the variable with another GSC star. V1733 Oph. Double; the redder, northwestern component varies. We are not sure which component is in GSC. V1950 Oph. Close double; Plaut marked the preceding, slightly redder component as variable. We are not sure which component is in GSC.

Table 2

No.	GCVS	α_{2000}	δ_{2000}
5	V1129 Oph	$16^{h}56^{m}47\overset{s}{.}0$	$-18°25'56"$
98	V1224 Oph	17 01 14.9	$-16\ 23\ 06$
429	V1548 Oph		
484	V1596 Oph	17 12 46	$-21\ 48.2$
497	V1611 Oph	17 12 59.3	$-19\ 00\ 57$
574	V1689 Oph	17 14 51.0	$-16\ 19\ 24$
732	V1839 Oph	17 18 54.0	$-21\ 01\ 23$
881	V1979 Oph	17 22 36.7	$-20\ 51\ 54$

The co-ordinates for six of them have been measured by us relative to neighboring GSC stars. There was a misprint by 1° in the declination of No. 484 = V1596 Oph in Plaut (1968); the l and b values given by Plaut for this star correspond to the correct declination. It is very difficult to explain the great difference (about 4°) between the co-ordinates measured by us and published by Plaut for the Mira variable No. 732 = V1839 Oph. The variable star is clearly marked in the chart, with comparison stars indicated.

We tend, to adopt our co-ordinates for this star. No confusion with other designated variables occurred in any of these cases as a result of changed co-ordinates. The finding chart for No. 429 = V1548 Oph shows the star identical with No. 408 = V1528 Oph, though their published co-ordinates differ considerably (the co-ordinates published for V1528 Oph agree with the position in the chart). V1528 Oph is a Mira variable, and V1548 Oph is a doubtful Nova discovered on two plate pairs, on both of which V1528 Oph was also discovered. So the two stars are, most probably, really different. The finding chart for V1548 Oph does not show comparison stars, while that for V1528 Oph shows them. We conclude that we have no reliable finding chart for V1548 Oph and cannot improve its position.

Finally, several notes on three more variables in the field. We have not been able to identify finding charts for NSV 8077 (Shajn, 1934) and NSV 8305 (Strohmeier *et al.*, 1966) with star fields around published positions; probably the co-ordinates are largely in error, or the charts are wrong. The position of Nova V906 Oph has been measured by us on prints sent to our group by W. Wenzel (Sonneberg) and found to be $17^h26^m09\overset{s}{.}7$, $-21°54'28''$, 2000.0, with probable accuracy about $\pm5''$. These co-ordinates differ considerably from those published by Solovyov (1956) and Khatisov (1971).

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FURTHER CONFIRMATION THAT THE Be STAR 27 CMa
IS A β CEP VARIABLE

The Be star 27 CMa (B3IIIe) was observed intensively by Balona *et al.* (1987) through the Strömgren b filter during 1986 and 1987. At that time the only period that was present was $P = 1.257$ d which is typical of a periodic Be star (λ Eri variable). The star was observed again in 1990 when a new short–period variation of $P = 0.0918$ d was discovered. The new period was still present in 1991 (Balona & Rozowsky 1991). The discovery of the onset of what appears to be β Cephei pulsations in a Be star is unique in two ways: 27 CMa it is the only β Cep star in which pulsations have been observed to begin and it is the only Be star which shows such short–period variations.

Pulsations in β Cep stars are driven by the ionization zone of metals, but we do not understand how pulsations can be excited so rapidly nor the more gradual decrease in amplitude seen in a few β Cep stars. Clearly, it is desirable to monitor 27 CMa from time to time to detect any change in amplitude and to determine whether these changes might be correlated with the mean brightness of the star as suggested by Balona & Rozowsky (1991).

We observed 27 CMa from two sites, CTIO (KK) and SAAO (LAB), during 3—9 January 1994. The observations at CTIO were made with the 0.6–m Lowell telescope through the Johnson V filter and a 3.7–mag neutral density filter. The observations at Sutherland were made with the 0.5–m telescope through the Strömgren y filter and a neutral density filter. We used HR 2734, HR 2741 and HR 2756 as comparison stars. The rms error of a single observation of the comparison stars is 3 mmag; all of them were found to be constant.

We obtained 89 V observations for 27 CMa from the two sites. The mean magnitude was $V = 4.45$ which is approximately equivalent to $b = 4.39$. Comparison with Balona & Rozowsky (1991) shows that the mean magnitude of 27 CMa during early 1994 was about the same as in 1991. In Fig. 1 we show the periodogram of these data as well as the periodograms of the 1990 and 1991 data for comparison. The semi–amplitude in 1994 is 4.3 mmag which is much
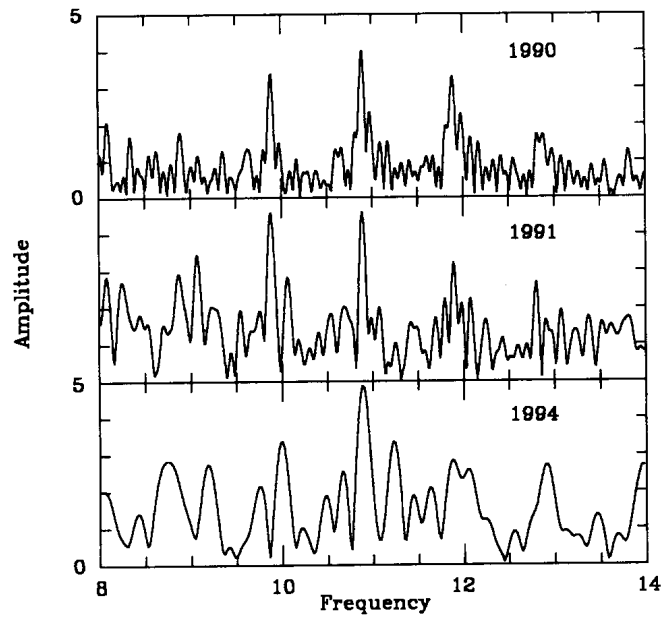
Figure 1: Periodograms of 27 CMa. Frequency is in d^{-1}, amplitude in mmag.
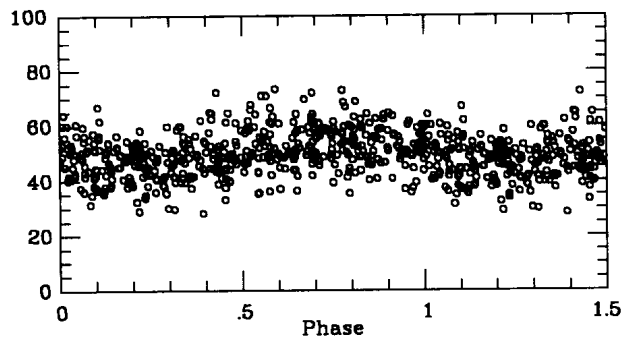
Figure 2: The light curve of 27 CMa. The magnitude scale is in mmag.

the same as in 1991 but perhaps slightly higher than in 1990. Fig. 2 shows the phase diagram with $P = 0.0918827$ d and epoch of phase zero at JD 2446000.000. This period may differ from the true value by one or more yearly aliases. The long λ Eri period of 1.257 d is probably still present in 1994, but our data set is not sufficient to verify this.

27 CMa is a close optical double with a difference in magnitude not exceeding 0.5 mag. It is therefore possible that the β Cep pulsations do not originate in the Be star itself, but this does not explain the sudden visibility of the pulsations. It has often been suggested that Be stars and β Cep variables are mutually exclusive. Yet most of the Be stars lie inside the β Cep instability strip and unless a hidden factor is at play, many of them should be β Cep pulsators. Rotation could be the hidden factor which suppresses pulsations, as seems to be the case in some other types of variables (δ Scuti and 53 Per stars for example). With $v \sin i = 139$ km s^{-1}, 27 CMa is not a particularly rapid rotator, so this possibility may still be true. If rapid rotation does suppress pulsations in these stars, however, it calls into question the idea that low-degree nonradial pulsation is responsible for the periodic light variations seen in a large fraction of Be stars (λ Eri variables).

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THE OBSERVATION OF SUPERHUMPS IN T LEONIS

T Leo, a SU UMa type dwarf nova experienced a superoutburst in March 30 ∼ April 9, 1994. Figure 1 shows the long term light curve around the superoutburst, characterized by a sudden increase, subsequent gradual decrease and steep decline at the end of the superoutburst. The abscissa is day count from the first day of the superoutburst (March 30, 1994 0.00 UT). The big arrow indicates the epoch of our observation which was in the midst of the superoutburst. The six smaller arrows indicate upper limits.

We observed this star on April 4, 1994 using 576 × 384 pixels Thomson CCD camera (TH7882CDA) attached to the Cassegrain focus of 60 cm reflector at Ouda Station, Kyoto University (Ohtani et al., 1992). The mode of 2 × 2 on-chip summation, the V-band filter designed to reproduce the Johnson V-band, and exposure time between 55 and 70 seconds were chosen to get a better time resolution but with sufficiently high counts. The observation was done for four hours, covering almost three superhump periods within one night, therefore no one-day alias problem arises in the period analysis.

The reduction was done using the personal-computer-based aperture photometry package developed by one of the authors (T.K.). This package enables us to de-bias, apply flat fielding and estimate the instrumental magnitudes automatically. The aperture size was $8''$ in radius and the sky level was determined from the pixels whose distance from the individual objects are between $16''$ and $30''$. Table 1 gives the coordinates and magnitudes of the comparison and check stars from Guide Star Catalog (GSC).

The short term light curve of differential magnitude between the object and comparison is shown in Figure 2. The constancy of comparison star was confirmed using nearby check stars. No systematic variation larger than its corresponding photon statistic error ($0^{m}_{.}03$ for check star in a single frame) was found during the observation. The expected error for one measurement of the differential magnitude between the object and comparison is about $0^{m}_{.}01$. One can clearly see the steep brightening and more gradual fading which are characteristics of superhumps.

The light curve was analyzed using PDM program within IRAF package (IRAF is distributed by National Optical Astronomy Observatories, U.S.A.). Figure 3 shows the Θ diagram, the abscissa is frequency per day. The lowest minimum point corresponds to 86.4 minutes period, the second lowest minimum corresponds to twice this period. For the estimation of error, another period analysis was made. We smoothed the curve and took the maxima, minima and the middle of rising and fading stages. From the distances between two adjacent points with the same phase we get the periods. The average of the periods was precisely the same with the PDM result, that is, 86.4 minutes, with the r.m.s. error of 0.4 minutes.

Table 1

	α_{2000}	δ_{2000}	m_v
Comparison	$11^h38^m16\overset{s}{.}71$	$+03°27'12''4$	11.9
Check 1	$11^h38^m13\overset{s}{.}37$	$+03°27'31''8$	13.1
Check 2	$11^h38^m30\overset{s}{.}56$	$+03°25'53''7$	14.0

T Leo, 4 Apr 1994

Figure 1

T Leo
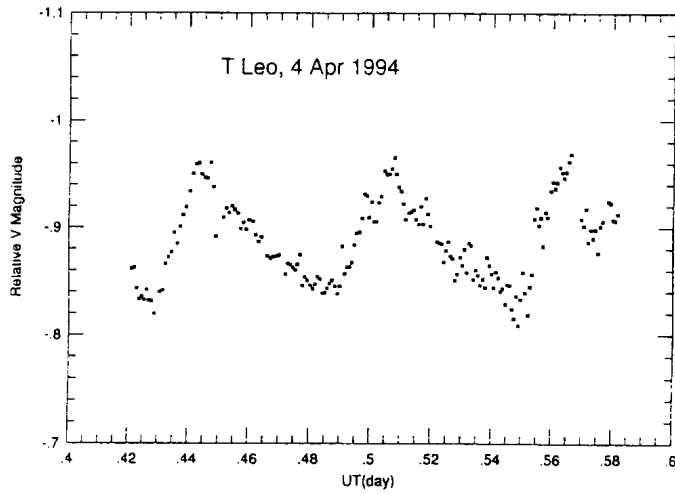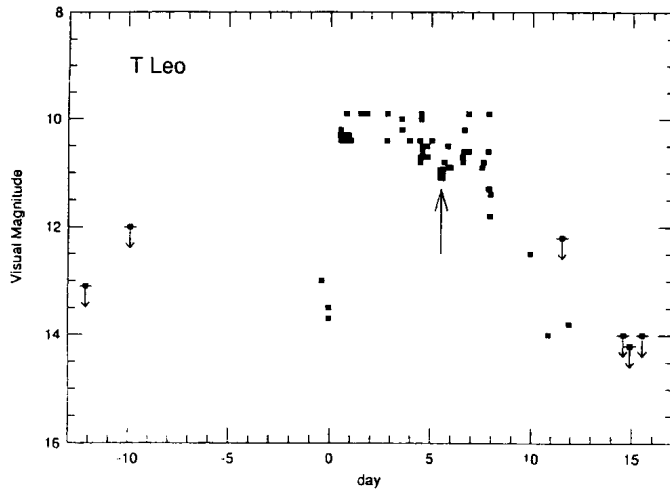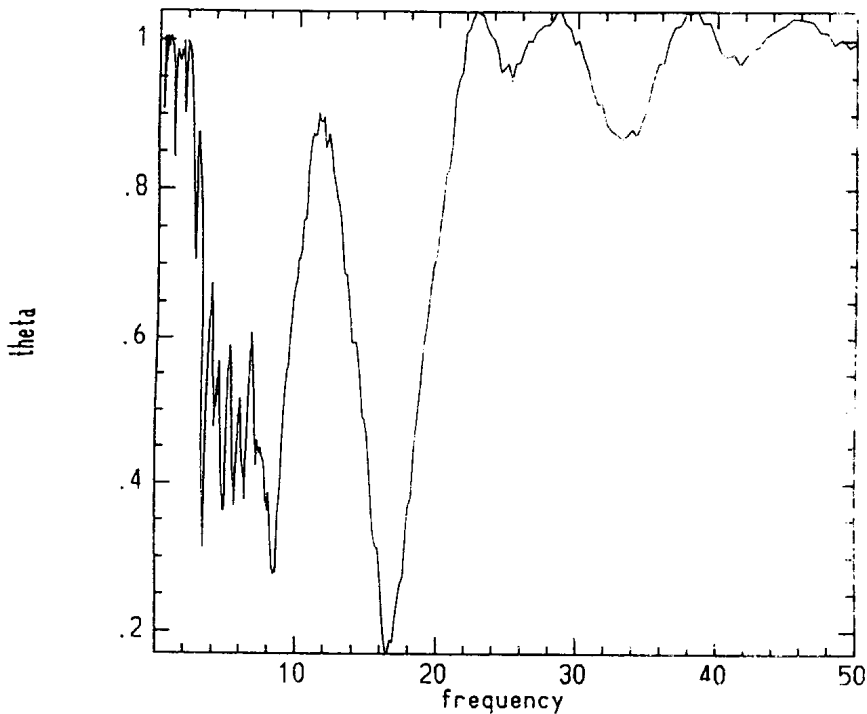
Figure 2

Figure 3

This observation gives us a chance to discriminate the true period between two pub lished values. Kato and Fujino (1987) found the period of 92.3 minutes, whereas the observations by Lemm et al. (1993) gave 86.8 minutes. One of these is probably the true period and the other is its one-day alias. The difference is small but crucial in judging whether this star is normal or peculiar from the view-point of fractional superhump period excess $\epsilon = (P_{superhump} - P_{orb})/P_{orb}$, (c.f. figure 1 of Molnar and Kobulnicky, 1992).

The period we found is clearly in good agreement with that of Lemm et al. (1993) This implies that T Leo is a normal SU UMa type dwarf nova in superhump period excess

4

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THE VARIABILITY OF HD 162211 = 87 HERCULIS
BETWEEN 1984 AND 1993

The bright K-giant star HD 162211 (= 87 Her = HR 6644) has been used traditionally as the primary comparison star for the UU Herculis-type variable V441 Her = 89 Her since the time of Worley's discovery of the variability in 89 Her (Worley 1956).

HD 162211 was chosen in 1984 as a comparison star for a program seeking long-term luminosity variations in a set of sun-like stars (Radick et al. 1989, Lockwood et al. 1992). After several seasons of data were acquired, a small secular drift was noticed in the brightness and color of the star when compared to two other stable stars. We reported on this change some years ago to John D. Fernie (University of Toronto), who has been using automatic photometric telescopes to monitor V441 Her using 87 Her as the primary comparison star. He reported on the drift as seen in the APT data in Fernie (1991). The change has also been observed by Donahue et al. (1993), who were likewise alerted to the variability from the data to be described here. Since our data have higher precision than the APT data, and cover the longest available baseline using fixed instrumentation, we present here the changes observed in the star from 1984 through the 1993 observing season.

The star was included originally in a trio involving HD 161239 = HR 6608 = 84 Her (the program star) and HD 162076 = HR 6638 (a second comparison star). The results for the program star HD 161239 will be discussed elsewhere and will not be mentioned further here. Because there was some activity in one or both of the comparison stars evident in the first year, a third comparison star (HD 160935 = BD+21°3188) was added from the second year onward. The stars were observed using the Lowell 53cm photometric telescope, which has a permanently-mounted photometer containing an EMI 6256S (S-11) photomultiplier and Strömgren b and y filters. On each night each star was measured twice in each filter using either a 29-arcsec or 49-arcsec diaphragm. Each measure consists of six 10-second integrations on 'star' and two 10-second integrations on 'sky'. The data were reduced to instrumental magnitudes, accounting for differential extinction using mean monthly extinction coefficients (cf. Lockwood & Thompson 1986). During episodes of volcanically-induced enhancements, the extinction values were adjusted to compensate at least approximately for this on a nightly basis, often from a direct determination of the extinction.

Basic data for the variable and two comparison stars are given in Table 1. We measured the stars against Strömgren standards on several nights in July and August 1993, and obtained the V and b-y values listed in the table. Comparable values published by Fernie (1986), Perry (1969), and Olsen (1983, 1993) are shown in the table as well. The standard deviations of the means are given as available in the second line of each entry.

Taylor (1986) considers both HD 162076 and HD 162211 to be supplementary standards on the VRI system. The first is a viable standard from the present differential observations and from those by Percy et al. (1979). But, as will be seen, the magnitude and color variations in HD 162211 are large enough to preclude its use as a high-precision standard star, although any variations are likely to be subdued in the R and I passbands.

Table 1. Basic Data for the Variable and Comparison Stars

Star	V	$b - y$	MK	Source
HD 160935	6.740	0.342	F8IV	Skiff, n=3
	.004	.003		
	6.733	0.347		Olsen (1983), n=3
	.006	.007		
	–	0.348		Perry (1969), n=2
HD 162076	5.693	0.581	G8IV	Skiff, n=3
	.008	.007		
HD 162211	5.091	0.717	K2III	Skiff, n=5, epoch 1993.6
	.001	.005		
	5.063	0.711		Olsen (1993), n=3/5, epoch 1984-85
	.006	.003		
	5.090	0.685		Fernie (1986), epoch 1984.5

The two comparison stars HD 160935 and HD 162076 have been sensibly constant over the most recent nine-season interval (HD 160935 was not added until the second season, as noted above). During this time the mean seasonal differential magnitudes averaged $\Delta y = -1.0495 \pm 0.0015(\sigma)$ and $\Delta b = -0.8297 \pm 0.0017(\sigma)$. Thus it seems reasonable to assume that HD 162076 was the same brightness during the first season. Table 2 summarizes the mean season differential magnitudes for HD 162211 minus HD 162076. The mid-season Julian date is given in the first column; 'n' is the number of nights in each mean.

Table 2. Differential Photometry of HD 162211 minus HD 162076

JD 2440000+	Δy	Δb	n
5884	−0.6387	−0.5247	11
6230	−0.6377	−0.5242	15
6613	−0.6361	−0.5226	11
6959	−0.6331	−0.5183	6
7376	−0.6280	−0.5127	6
7756	−0.6228	−0.5050	7
8062	−0.6104	−0.4903	8
8424	−0.6017	−0.4848	2
8799	−0.6043	−0.4809	9
9152	−0.5995	−0.4760	11
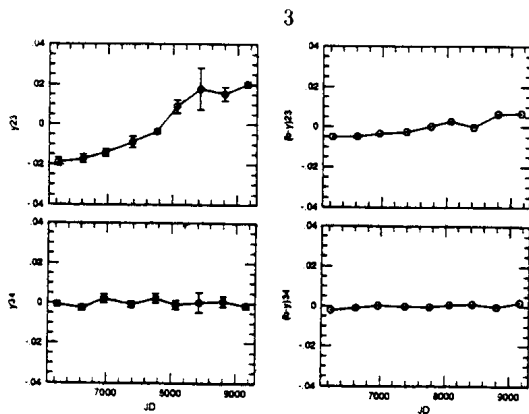
Figure 1

The values in Table 2, normalized to the grand mean, are plotted in Figure 1. The upper panel shows the seasonal means for HD 162211 minus HD 162076 in y and $b - y$; the lower panel shows similar data for the two comparison stars. The error bars represent 95-percent confidence intervals.

HD 162211 has faded by about 0.04 mag. in y and nearly 0.05 mag. in b, i.e. the star has also become 0.01 mag. redder in $b - y$. This is consistent within mutual errors with the standard measures in Table 1 by Olsen and ourselves, and with the extensive APT data presented by Fernie (1991). In contrast, Donahue et al. (1993) claim a brightening of about 0.07 mag. in V for the period 1986-1992 based on a comparison with μ Herculis (86 Her = HD 6623 = HD 161797). Even assuming that a simple sign error was made in the presentation, their claimed amplitude is too large, suggesting a systematic problem in their APT data.

The long-term variations appear to describe half or more of a sinusoid with a period of approximately 15 years. One might simple-mindedly suggest that this represents an example of the warm, low-amplitude end of cyclical, pulsational variations commonly present in M giants. Alternatively, the variation might result from a mechanism more nearly analogous to magnetic-cycle luminosity variations in cool dwarf stars. These sorts of variations in giants are, in any case, previously unexplored because of the long time spans and small amplitudes involved, requiring observations of few-tenths-percent precision over decades-long timescales. In coming years, improvements in the precision of photometry from APTs should allow more such stars to be reliably observed.

Photometry of this star continues as a part of the sun-like stars program at Lowell Observatory. Concomitant high-resolution spectral analysis and radial-velocity monitoring would shed light on the source of the variations.

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UBV PHOTOMETRY OF CH CYGNI IN 1993: INCREASING ACTIVITY

During the recent years (since 1989), renewed activity on CH Cyg has been observed, including strong and variable blue continuum, broad and variable emission lines and rapid light variability (Leedjarv, 1990; Tomov and Mikolajewski, 1992, Kuczawska et al., 1992, Panov and Ivanova, 1992). The erratic activity has been interrupted by more quiet periods, but generally, the 1992-1993 observations show a trend of increasing activity (Leedjarv, 1993). In a recent paper Hinkle et al. (1993) proposed a triple-star model for CH Cyg, in which the symbiotic pair is in a 756 day period orbit. The long period orbit (14.5 yr) involves a third (unseen) star and probably has no implications to the CH Cyg activity (Hinkle et al., 1993). This is a major revision of previous orbit solutions, resolving a long-standing problem. Here we report our UBV photometry of CH Cyg, obtained in August-September, 1993 with the 60 cm telescope of the Bulgarian National Astronomical Observatory at Rozhen. We used a single channel, photon counting, computer controlled photometer. The integration was 10 sec and one observation (Comparison – CH Cyg – Comparison) is a mean of 4 consecutive integrations in each U, B, V filter. Mean nightly points were obtained from 3-4 individual observations and corrections were applied for dead-time, differential extinction and standard transformation. The UBV magnitudes are derived in respect to the comparison star HD 182691 (V=6.52, B−V=−0.08, U−B=−0.23) and they are shown in Table 1. From Table 1, it is apparent that the blue continuum became even stronger, compared to August, 1992 (Panov and Ivanova, 1992). The U mag was generally brighter than 8 during the observational period and our data are consistent with the photometry of Leedjarv (1993). The U−B index reached values near −0.90 and the visual mag began to increase, being in the range 7.7-8.1. On two nights, Aug 22 and Aug 23, 1993, we monitored CH Cyg for rapid light variations, which are shown in Figure 1 and Figure 2, respectively. (Integration was 1 sec). In the upper panel, the comparison star BD+49°2997 is shown for each night. Note that the observations in U, B, V filters are subsequent, with a time-delay of about 1-2 min between respective filters. The flickering is most pronounced in the U and B filters with amplitudes of 0.30 mag and 0.36 mag, respectively.

However, there is a clear flickering in the V filter also (amplitude: 0.14 mag). Kuczawska et al. (1992) reported flickering in all UBVRI-filters. The flickering is ascribed to mass transfer to the hot companion.

Leedjarv (1993) discussed the possibility that the 1993-increase of the visual brightness of CH Cyg is due to the rotation of the M star with a period of 770 days (Kuczawska et al., 1992). However, in their triple-star model, Hinkle et al. (1993) suggested that the 770 d photometric variations result from the heating of the M star by the hot companion.

2
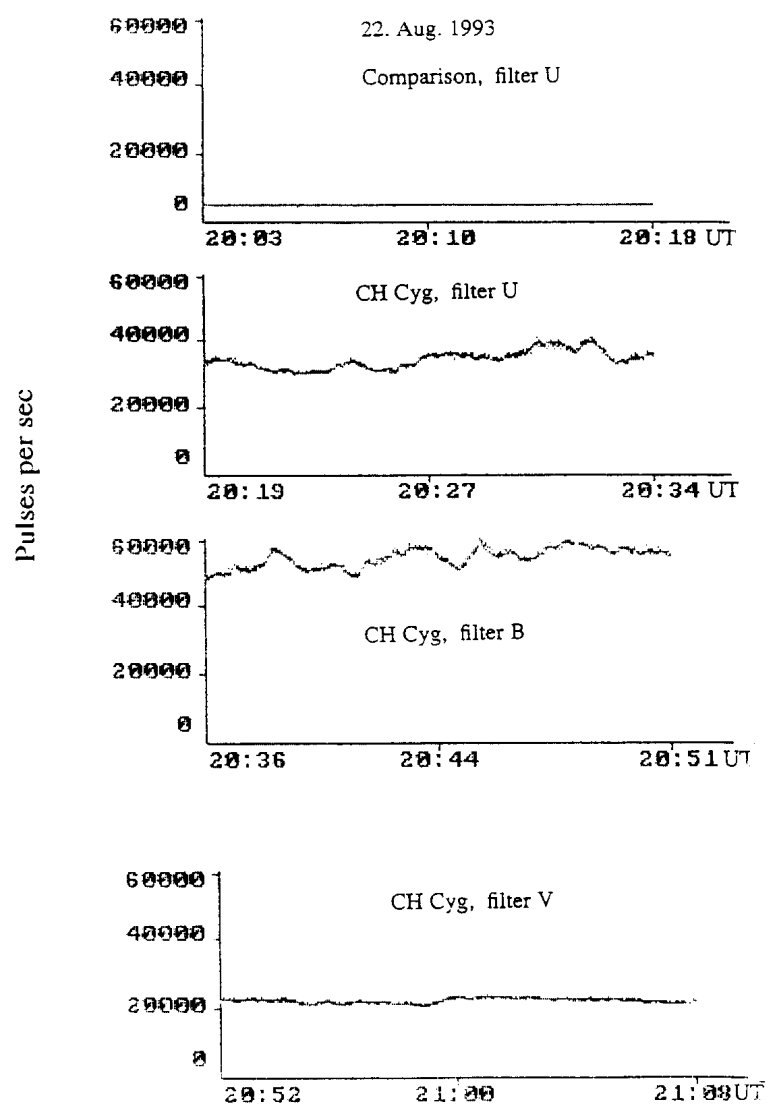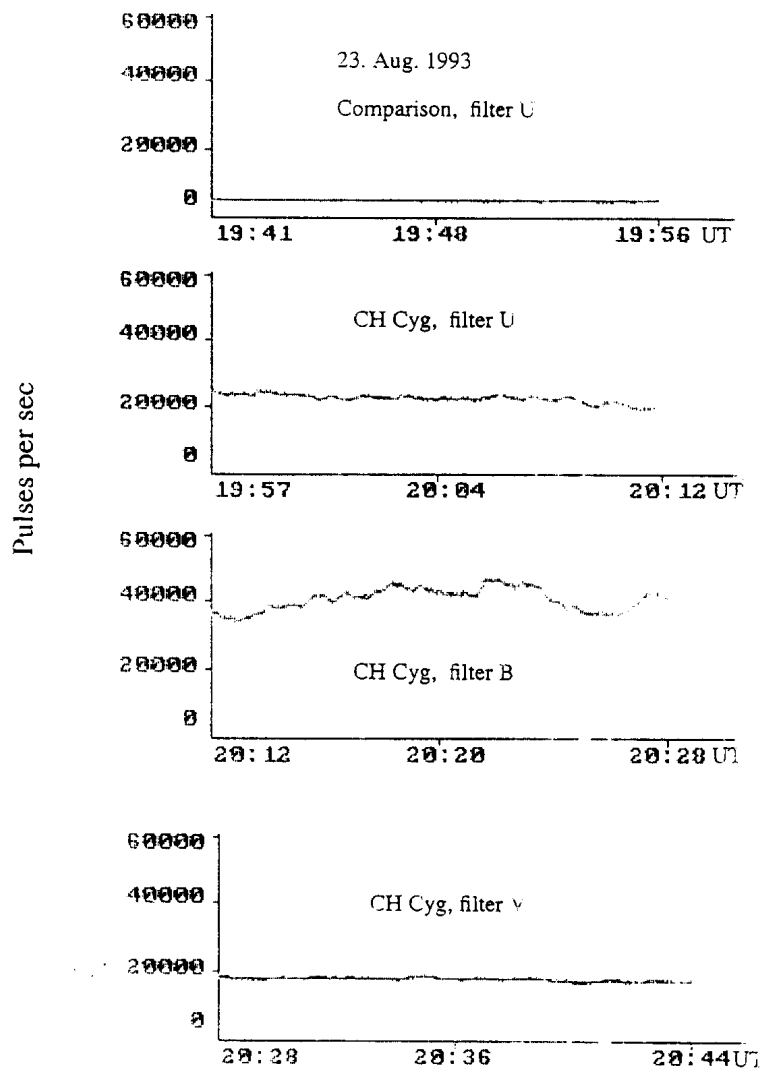
Figure 1

Figure 2

Table 1. UBV photometry of CH Cygni

JD 2400000+	V	B	U	B−V	U−B
49212.361	7.69	8.43	7.58	0.74	−0.85
49220.372	7.91	8.75	7.87	0.84	−0.88
49221.335	7.85	8.61	7.74	0.76	−0.87
49221.468	7.83	8.61	7.77	0.78	−0.84
49222.324	7.85	8.55	7.62	0.70	−0.93
49222.498	7.70	8.37	7.44	0.67	−0.93
49223.309	7.93	8.83	7.93	0.90	−0.90
49224.313	8.06	8.97	8.07	0.91	−0.90
49224.493	8.01	9.00	8.19	0.99	−0.81
49225.305	7.83	8.60	7.73	0.77	−0.87
49233.322	8.01	8.77	7.82	0.76	−0.95
49233.470	7.97	8.68	7.76	0.71	−0.92
49234.334	7.91	8.66	7.79	0.75	−0.87
49235.303	8.03	8.82	7.97	0.79	−0.85

Indeed, the two periods (770 d photometric and 756 d orbital) are very close. Fom our observations, it looks that the brightening of CH Cyg in the visual band results from the hot continuum, which already veils the M star in all UBV filters. The flickering is an indication of the presence of that continuum. From previous extended outburst of CH Cyg it is well known, that the hot continuum appears first at short wavelengths. With the progress of the outburst, the veiling continuum gets stronger and spreads to longer wavelengths. If so, the veiling in the V band in 1993 shows further increase of the CH Cyg activity.

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FG Sge: RISE FROM MINIMUM

FG Sge is a post-AGB star which displays strong changes of brightness. It brightened from 13.6 mag_{pg}. in 1894 to 9.6 mag(B) in 1965 (Herbig and Boyarchuk 1968) but only small variations were detected in recent years. Rapid decline of brightness began in August 1992 (Papoušek 1992). The lightcurve of the decrease of brightness was published by Jurcsik (1992).

FG Sge was observed with a CCD camera ST-6 attached to a Maksutov telescope 180/1000 mm in Ondřejov Observatory in 1992–1994. The observations were carried out in an instrumental V-band. FG Sge and the comparison stars were captured in the same image and the expositions lasted 60–120 seconds. The set of 2 or 3 comparison stars (always the same) was used for determining the brightness of FG Sge on each image and an average value was calculated. These data covering the mimimum and the rise of brightness are presented in this paper.

FG Sge has a companion in a distance of 8 arc sec. Only the composed brightness of these two stars could be measured on the CCD images. The exact brightness of this companion has not been published so far but its approximate value is 12.5 mag(V). The brightness of this companion was determined using the spectrophotometric data of Stone et al. (1993). One of their observations was carried out on the same night as the data in this paper (JD = 48 956). Their magnitude of FG Sge alone was 13.06 mag(V) on this night. Brightness of the companion = 12.81 mag(V) was determined using the average of $mag_{tot.}$(V) in the CCD data No. 5, 6 and 7.

The CCD data are listed in Table 1. The column mag_{FG}(V) refers to V-magnitude of FG Sge assuming brightness of the companion is 12.81 mag(V). The column $mag_{tot.}$(V) refers to the total brightness of FG Sge and its companion. The data in this column enable recalculating the magnitude of FG Sge when better data of the companion are known. The standard deviation of $mag_{tot.}$(V) lies in the range of 0.01–0.03 mag.

Table 1: CCD data in 1992–1993. $Mag_{tot.}$(V) refers to the total brightness, mag_{FG}(V) refers to V-magnitude of FG Sge assuming brightness of the companion is 12.81 mag(V).

N	HJD	$mag_{tot.}$(V)	mag_{FG}(V)
1	48954.2863	12.14	12.98
2	48954.2877	12.14	12.98
3	48954.2905	12.10	12.91
4	48956.2508	12.07	12.83
5	48956.2563	12.15	13.01
6	48956.2702	12.19	13.09
7	48956.2716	12.18	13.08
8	48972.2241	12.05	12.79

Table 1:-cont.

N	HJD	mag$_{tot.}$(V)	mag$_{FG}$(V)
9	48972.2262	12.04	12.78
10	49168.4282	11.56	11.97
11	49168.5029	11.46	11.84
12	49207.3622	11.05	11.29
13	49207.4231	11.07	11.31
14	49213.4201	11.02	11.25
15	49213.4237	11.00	11.23
16	49215.4637	10.98	11.21
17	49215.4463	10.95	11.17
18	49216.3632	10.95	11.17
19	49216.3700	10.99	11.21
20	49247.3435	11.00	11.23
21	49247.3473	10.99	11.22
22	49249.3104	11.02	11.26
23	49250.3263	10.98	11.20
24	49258.3338	10.93	11.15
25	49266.3327	10.92	11.13
26	49290.2979	10.74	10.92
27	49291.2690	10.67	10.83
28	49292.2350	10.65	10.81
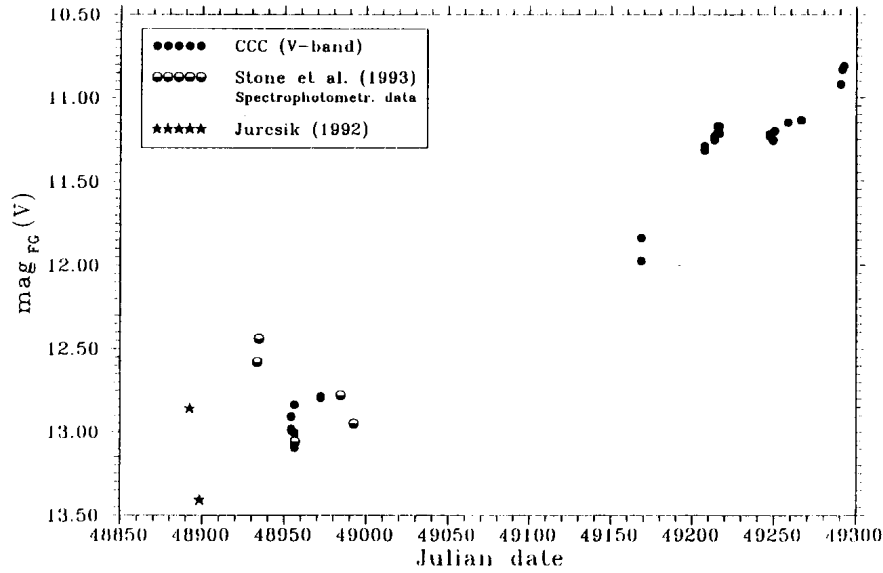
Figure 1: The lightcurve of FG Sge in November 1992–October 1993

3

The CCD data are plotted in Fig.1 together with the data of Stone et al. (1993) and of Jurcsik (1992). The variations of brightness of the order of several tenths of magnitude can be seen even in the time of the deep minimum. The timescale of these changes was several days long.

The rise from minimum which had begun in 1993 continued in an irregular manner with a possible plateau on JD = 49 212- 49 250.

I wish to thank dr. Hudec and Mgr. Pravec for making the CCD camera accessible to me.

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TIMES OF MINIMA FOR SOME ECLIPSING BINARIES

Eighteen minima for seven eclipsing variables have been determined photoelectrically
These stars were observed during several seasons. All observations were obtained with
the 30 cm Maksutov telescope of the Ankara University Observatory. Differential obsei
vations were secured by using an EMI 9789QB photomultiplier before 29 September 1991
and an SSP5A (with a Hamamatsu R1414 photomultiplier) photometer after that date
The filters used are in close accordance with the standard UBV and reductions of the
observations have been performed in the usual way (Hardie, 1962)

Table 1

System	Min	HJD 2440000+	Std. Err.	Filters	Obs
HS Her	I	7387.33721	0.00111	U,B,V	Gr
HS Her	I	7657.51786	0.00094	U,B,V	My
BF Aur	I	7499.55257	0.00127	U,V	Gi
BF Aur	I	7561.29777	0.00354	U,B,V	My
BF Aur	II	7595.33127	0.00139	U,B,V	Kh
KR Cyg	I	7712.43253	0.00113	U,B,V	Sl
V346 Aql	I	7713.51051	0.00057	U,B,V	Oz
LS Del	II	8472.43681	0.00317	B,V	Od
W UMa	I	9444.40554	0.00035	U,B,V	Tn
W UMa	I	9454.41302	0.00031	B,V	Sl
V456 Oph	I	7346.3411	0.0006	B,V	Kh
V456 Oph	I	7347.3579	0.0010	B,V	Kh
V456 Oph	I	7348.3730	0.0011	B,V	My
V456 Oph	I	7349.3903	0.0013	B,V	Kh
V456 Oph	I	7351.4211	0.0004	B,V	Or
V456 Oph	II	7377.3338	0.0009	B,V	Sl
V456 Oph	II	7382.4136	0.0010	B,V	Ak
V456 Oph	I	7732.4223	0.0005	B,V	Kh

Observers: AK: A. Akalin; Gr: B. Gürol; Kh: G. Kahraman; My: Z. Müyesseroglu; Od
S. Özdemir; Or: F. F. Özeren; Sl: O. Selam; Tn: M. Tanriver

The times of minimum light and standard errors for each filter were calculated using the method of Kwee and van Woerden (1956). The algorythm of this method was applied to the computer by Müyesseroğlu. The weighted averages for these values are given in Table 1 together with their minimum types, filters and observers.

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FURTHER PHOTOMETRY OF α Ori AND γ Ori

We present photometry of α Ori and γ Ori, obtained differentially with respect to ϕ^2 Ori (V = 4.09, B−V = 0.95). These data were obtained from November 1992 to April 1994, primarily with a 15-cm reflector at the 2800-m elevation of Mauna Kea in Hawaii. The data of 8/9 January 1994 were obtained with the Lowell 0.6-m telescope at Cerro Tololo, stopped down to about 0.36-m, and using a 3.7 magnitude neutral density filter. Transformation coefficients for conversion of the data to the UBV system were obtained from observations of red-blue pairs (Hall 1983). Typically, each data point on α Ori in Table 1 and Figure 1 represents three bracketed differential measures. For previous data see Krisciunas and Fisher (1988), Krisciunas (1990), and Krisciunas (1992).

Guinan et al. (1993) noted the relatively rapid decrease in brightness of α Ori by nearly 0.5 magnitude from October 1992 to February 1993 (≈JD 2448900 to 9000). A previous such dimming, by 0.7 mag, occurred from April 1988 to February 1989 (≈JD 2447300 to 7600).

Krisciunas and Fisher (1988) noted that the check star, γ Ori, was variable. Since this star is one of the secondary standards of the UBV system (Johnson, 1963) one might say that its V magnitude is, *by definition*, 1.64. But when we have carried out all-sky photometry, multiple measures of γ Ori have been noted to be inconsistent with each other, and their mean value can indicate that γ Ori does not always fit with other standards. We believe that ϕ^2 Ori is constant and that γ Ori is a low amplitude (irregular?) variable.

Table 1. Photometry of α Orionis

Date	<UT>	Julian Date	V		B-V
25/26 Nov 1992	0834	2448952.8569	0.581 ± 0.015		
24/25 Jan 1993	0803	9012.8354	0.838	0.008	
18/19 Feb 1993	0648	9037.7833	0.858	0.002	
14/15 Mar 1993	0601	9061.7507	0.881	0.002	
23/24 Mar 1993	0559	9070.7493	0.891	0.009	
28/29 Mar 1993	0636	9075.7750	0.835	0.016	
13/14 Apr 1993	0632	9091.7722	0.864	0.012	
22/23 Apr 1993	0602	9100.7514	0.823	0.019	
8/9 Sep 1993	1450	9240.1180	0.818	0.013	
10/11 Nov 1993	0914	9302.8851	0.588	0.018	
19/20 Dec 1993	0753	9341.8313	0.607	0.003	
20/21 Dec 1993	0924	9342.8917	0.589	0.006	
8/9 Jan 1994	0406	9361.6706	0.693	0.001	1.871
6/7 Mar 1994	0645	9418.7813	0.666	0.015	
7/8 Apr 1994	0607	9450.7552	0.651	0.012	

α Ori and γ Ori
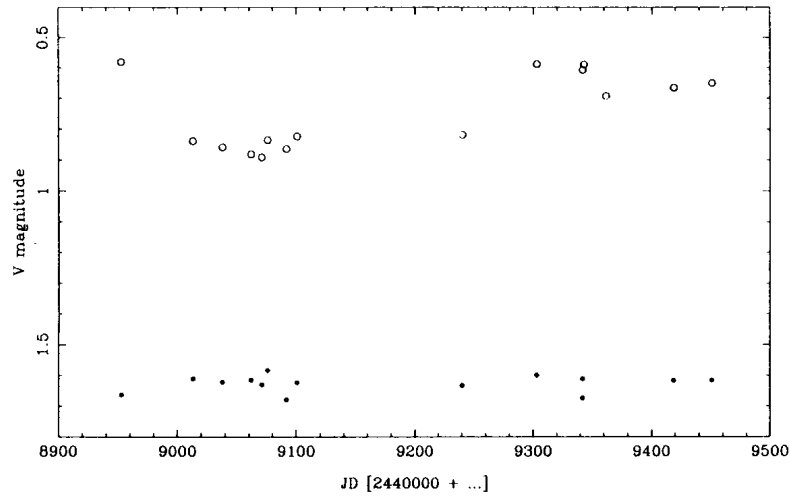
Figure 1 - Photometry of α Ori (open circles) and
γ Ori (dots), derived with respect to ϕ^2 Ori.

γ Ori (Nov 1986 to Apr 1994)
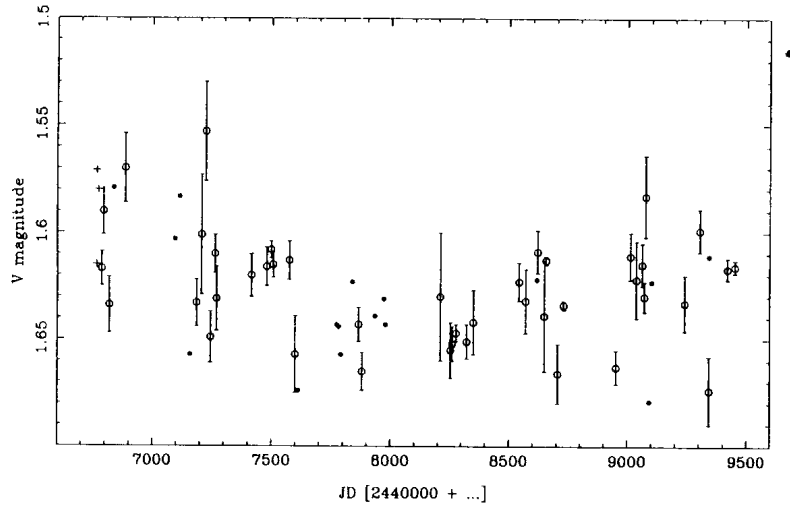
Figure 2 - Photometry of γ Ori, derived with respect to
ϕ^2 Ori. Pluses: data of David Fisher. Open circles:
Krisciunas data, based on two or more differential measures.
Dots: Krisciunas data based on a single differential measure.
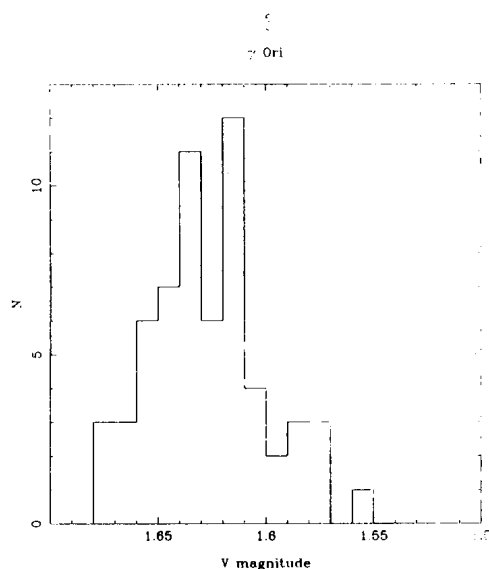
Figure 3 - Histogram of data in Figure 2.

In Figure 2 we give the γ Ori data of the last eight observing seasons. The mean V magnitude is 1.626 ±0.004, and the standard deviation of the distribution is ±0.027 mag, based on 61 nightly means. In Figure 3 note the evidence for a bimodal distribution of values.

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Krisciunas, K., 1992, *IBVS*, No. 3728

IQ Cyg = V 1290 Cyg

During my work on *PICA project* (Precise Identification and Coordinate Adjustment of about 7000 variables) I have found that *IQ Cyg* is identical with *V1290 Cyg*.

IQ Cyg = 315.1929 was discovered by Hoffmeister (1929), giving only range of light changes and Mira-type variability. A finding chart was published by Hoffmeister (1930). The star has received its final designation in 1931 (Guthnick, Prager, 1931). Ahnert (1941) published results on this star giving times of 3 maxima, period and more precise range of light variations. This is the only work found to deal with *IQ Cyg* light variations.

V1290 Cyg = VV 220 was found to be variable by Miller (1968). He gave a detailed study of this star, together with finding chart. The star has received its final designation in 1970 (Kukarkin et al., 1970). Miller's paper is the only one found to deal with *V1290 Cyg* at all.

While working on field variable stars around *SY Cyg* I have noticed that the charts for both above mentioned stars in fact refers to one star (see Figure 1). There remained one problem concerning the reported periods – 304 days (by Ahnert) and 363 days (by Miller). As Ahnert's observations are more scarce than Miller's, the 363 days looked better. A bit of computing confirmed that a period adjustment to 356 days is possible for all maxima earlier than JD 2433480, while later maxima are well represented with 366 day period. But even with this correction there remained one problem to be solved. Ahnert states the star being < 17 pg in the interval JD 2429050 – 2429250, while Miller gives a maximum at JD 2429135. At present time I am not able to solve this remaining discrepancy – a check of star's behaviour on archival plates is needed.

Name	Position (B1950)		Position (J2000)		Type	Max	Min	Phot.
	h m s	° '	h m s	° ' "		mag	mag	system
IQ Cyg	19 45 12	+32 17.8	*19 47 08*	*+32 25.3*	M	14.4	< 17.5	p
V1290 Cyg	19 44 54	+32 18.0	*19 46 50*	*+32 25.4*	M	14.7	< 17.5	p
VV 220	*19 44 53.59*	*+32 17 57.5*	*19 46 49.59*	*+32 25 24.0*				
GSC 2660.1432	*19 44 53.59*	*+32 17 56.3*	19 46 49.59	+32 25 22.8		10.55		1

Table 1: Comparative table of *original* data for IQ Cyg, V1290 Cyg, VV 220 and GSC 2660.1432. Data concerning IQ Cyg and V1290 Cyg are from GCVS, data for VV 220 are by Miller (1968) and data for GSC 2660.1432 are from GSC. Photometric system code 1 for GSC represents the Kodak IIa-D plate with W12 filter. In GSC there are two entries for this star, reported coordinates are weighted means. The magnitude of second entry, 10.27, doesn't contradict the 366 day period, as the GSC plates were taken 364 days apart. Coordinates printed in italics were computed from the above stated data sources.
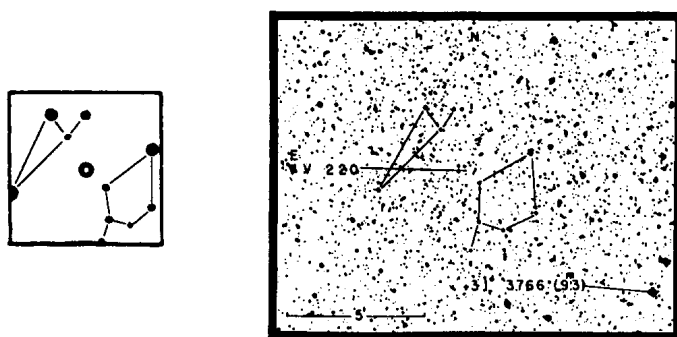
Figure 1: Left: enlarged finding chart for IQ Cyg = 315.1929 (circle) by Hoffmeister (1930). Size of box is 6'. Right: the same region for V1290 Cyg = VV 220 adapted from Miller (1968). Labeling of comparison stars was removed from Miller's chart and both charts have lines added to make easier their comparison. North is up on both charts. According to coordinates *originally* reported for IQ Cyg this star should be located almost exactly on the place of zero in the VV 220 label of Miller's chart. The star immediately north (only 9") of VV 220 is GSC 2660.0988 and may be source of troubles in brightness estimates on not-perfect plates.

The reported coordinates for *IQ Cyg* were found to be somewhat off the star's real position, while those reported for *V1290 Cyg* are good. As this star is identical with GSC 2660.1432 the J2000 coordinates were easily found (see Table 1).

Following cross-identifications are valid : IQ Cyg = V1290 Cyg = 315.1929 = VV 220 = GSC 2660.1432.

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POSITIONS FOR STARS IN THE FIELDS OF
UX ANTLIAE AND UW CENTAURI

Recently in these Bulletins, Milone (1994) provided UBV photometry for stars in the fields of the R CrB-type stars UX Antliae and UW Centauri. Although finder charts were provided for these stars, identifications and positions were not. Since modern or modernized telescopes usually have good pointing ability, it is useful–even necessary–to have accurate positions to operate the telescope efficiently. Furthermore, there is no need to give new names to stars that already appear in widely available catalogues. I have extracted positions from the Guide Star Catalogue (GSC) for all the stars observed by Milone, and also made identifications in traditional star catalogues for the brighter ones.

Table 1. Positions for the variables

	RA (2000)	Dec	
UX Ant:	$10^h57^m09\!.^s0$	$-37°23'56"$	(GSC)
UW Cen:	$12^h43^m17\!.^s1$	$-54°31'40"$	(GSC)
	17.1	40	(Villada 1980)
	17.0	40	(Torres et al. 1985)
	15.7	32	(IRAS)

In Tables 2 and 3 are the positions for the comparison stars measured by Milone. The letter names are those given on Milone's charts. The companion 15 arcsec NW of UX Ant mentioned by Milone does not appear in the GSC. Also, none of the close pairs mentioned is resolved in the GSC.

Table 2. Positions and identifications for stars near UX Antliae

Names	RA (2000)	Dec	Other IDs
A = CoD−36°6800	$10^h56^m15\!.^s3$	$-37°18'36"$	CPD−36°4696
B = GSC 7724-2159	10 57 08.6	-37 30 55	CoD−36°6813=CPD−36°4704
C = GSC 7211-1506	10 56 28.2	-37 10 25	
E = GSC 7212-0122	10 57 10.7	-37 13 44	CoD−36°6814
F = GSC 7212-0258	10 57 03.9	-37 24 24	CoD−36°6812 = CPD−36°4703
G = GSC 7212-0355	10 57 50.9	-37 27 52	CoD−36°6822
H = GSC 7212-0025	10 57 32.6	-37 22 57	

Table 3. Positions and identifications for stars near UW Centauri

Names	RA (2000)	Dec	Other IDs
A = HD110445	$12^h42^m39\!.\!2$	−54°32'18"	CPD−53°5285
B = HD110517	12 43 14.7	−54 24 35	CPD−53°5291
C = HD110551	12 43 26.7	−54 38 50	CPD−53°5294
D = GSC 8651-0342	12 43 59.0	−54 26 20	
F = GSC 8651-0814	12 43 47.6	−54 26 16	
G = GSC 8651-0586	12 43 45.2	−54 34 39	
H = GSC 8651-0546	12 43 30.1	−54 32 13	
I = GSC 8651-0894	12 43 26.1	−54 32 43	
J = GSC 8651-0400	12 43 32.7	−54 31 28	
K = GSC 8651-600	12 43 11.2	−54 28 03	
− GSC 8651-0720	12 43 16.0	−54 31 20	= comp 20" NNW of UW Cen

Both variables appear in the GSC. UX Ant = GSC 7212-0077. UW Cen has several identifications: CPD−53°5293 = CoD−53°4775 = IRAS 12404-5415 = GSC 8651-0852. In the case of UW Cen, the GSC position merely confirms high-precision measures published previously. The IRAS identification for this star appears secure: although the IRAS position is offset somewhat, the precise positions fall well within the error ellipse. Positions for the variables are given from various sources in Table 1 for equinox 2000.

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V1177 Cyg = NSV 12848

During my work on *PICA project* (Precise Identification and Coordinate Adjustment of about 7000 variables) I have found that *V1177 Cyg* is identical with *NSV 12848*.

NSV 12848 = comparison star F for VV 101 (=V1039 Cyg) was suspected to be variable by Miller (Miller, Wachmann 1962). In 1982 it was included in the New Catalogue of Suspected Variable Stars (Kholopov et al., 1982).

V1177 Cyg = VV 171 was studied in detail by Miller (1966). The star has received its final designation in 1968 (Kukarkin et al., 1968).

While working on field variable stars around *V1770 Cyg* I have noticed that the charts for both above mentioned stars in fact refer to one star. This became clear also after checking the text of both articles. In the earlier one in the note for VV 101 is stated that *"Star F is still another variable .... ; detailed data on this variable will be reported in a future paper."* In the later article in the note for VV 171 is stated that *"This variable is the same as the star marked as F on the identification chart of VV 101 and mentioned in the last sentence of the text ... of the VV 101 paper."* The link between these two stars is therefore more than clear.

The reported coordinates for *V1177 Cyg* seem to be quite good. However no star is listed in GSC at this position. Re-measuring of position will be made later.

Following cross-identifications are valid : V1177 Cyg = VV 171 = NSV 12848

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THE VARIABILITY OF W134

Padgett and Stapelfeldt (1994) discovered this member of NGC 2264 to be a double–line Pre–Main Sequence(PMS) close binary. They also pointed out that its near–IR flux excess indicates the presence of a circum–binary disk of warm dust.

The possibility of removing the projection factors from the spectroscopic masses and orbital radius suggested exploratory photometry, for the object could be an eclipsing or ellipsoidal variable. The prospect for the second of these possibilities could not be high since the stars are fractionally small in terms of the orbital radius. But for PMS binaries with less than MS central condensation, those chances were also not negligible. In addition, the published V magnitudes from Walker (1956), Mendoza and Gomez (1980), Sagar and Joshi (1983), and Feldbrugge and van Genderen (1991) vary from +12.30 to +12.67. Some variability, therefore, had already been demonstrated.

W134 had also been studied by Koch and Perry (1974) who noted that their KPNO V magnitudes were too faint, the star being vignetted (by the internal north edge of the camera). Even though this geometrical optical bias exists, the plate/filter response is still on the V system. Furthermore, because the plates were taken with the automatic, image–dissecting guider using the same scale setting on the same guide star for each of the 4 nights, the vignetting is constant for all the nights. These data, for which the standard deviation for 1 plate is ±0.06 mag, are shown in Figure 1. It is clear that the object did vary in light in December, 1970 with an amplitude of about 0.35 mag in V. According to the ephemeris of Padgett and Stapelfeldt, the orbital nodes were passed at 49.79 and 52.98 and the inferior conjunction of the A–component occurred at 51.38 (all on the given abscissa scale). A minimum of light appears to have occurred around this conjunction but higher frequency variability is also prominent and forbids identifying the minimum with an eclipse or an ellipsoidal–variable minimum. Because of the hyperboloid's diffraction pattern from S Mon, the 20 FCO plates described by Koch and Perry are not useful for extending the 1970s history of W134.

As soon as the binarity of W134 was announced and even though the observing season was more than half over, the object was added to the local photometric observing program using the 4–channel polarimeter as a single–channel photometer. The instrument was mounted on the 0.72–m reflector of the Flower and Cook Observatory. W158 and W137 were chosen as local reference stars despite a history of possible variability for the latter. W158 appeared to be constant within ±0.03. Among the 8 measures of W137 in 1994, peak–to–peak variability is 0.10 in V and 0.05 in R. These ranges fall within its historical range so most probably the object is slightly variable in light. Nebulosity and scattered

light from S Mon could be troublesome so care was taken always to measure sky brightness halfway between W158 and W134. The observations of W134 listed in Table 1 are nightly means of 15 15–sec integrations each and were accumulated within 20 minutes each night. The internal standard deviation of each mean is ±0.02, and the nightly standardizings are accurate to ±0.03. Phase is calculated from Padgett and Stapelfeldt's ephemeris.

Table 1. *V* and *R* Observations of W134

JD minus 2,449,000	Phase	*V*	*R*
390.501	0.819	+12.54	+11.40
398.555	0.087	+12.47	+11.30
402.520	0.712	+12.60	+11.45
410.514	0.970	+12.65	+11.47
411.509	0.126	+12.56	+11.49
422.532	0.861	+12.45	+11.38
423.526	0.018	+12.47	+11.30
428.516	0.803	+12.44	+11.37
442.530	0.009	+12.78	+11.66
443.550	0.170	+12.47	+11.30
449.546	0.113	+12.63	+11.40
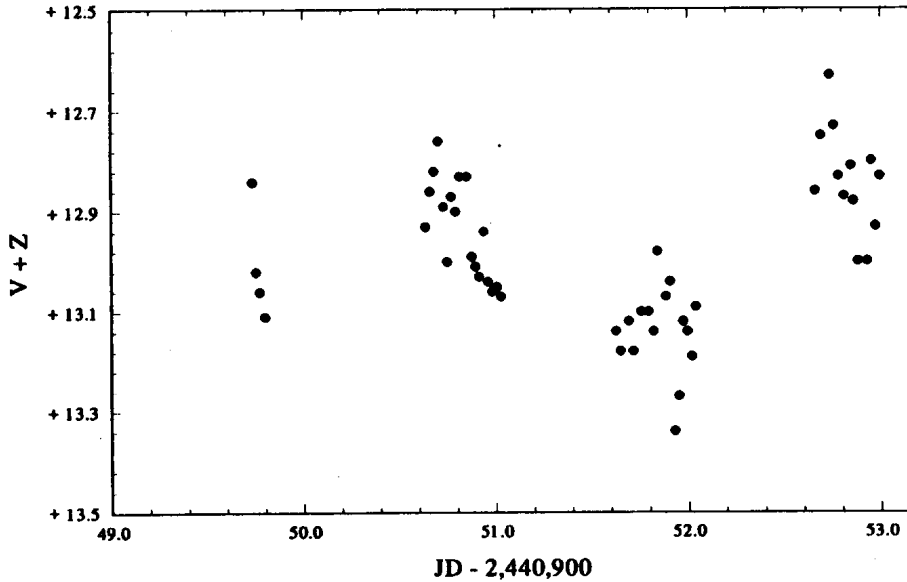
Figure 1. The photographic *V* light curve of W134 in December, 1970 with the No. 1 0.9–m KPNO reflector. The unknown value of the camera vignetting is signified by the unspecified zero–point correction(Z) for the ordinate.

The object varies over ranges of about 0.35 mag in V and R. Each of these amplitudes is comparable to the historical ranges already reported by other photoelectric observers and is also comparable to the KPNO photographic range. Furthermore, V is not correlated with $V-R$. The 1994 observations contain data close to the descending node (0.00P) of the A-component and also close to both conjunctions (0.25P, 0.75P) of the stars. No phase-locked variability is apparent and, if any is present, it is lost in the sporadic variability. Most likely, the persistent peak-to-peak variability of about 0.35 mag is the characteristic activity level associated with the systemic disk. The observing season ended after the last measure listed in Table 1.

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IO DELPHINI – CLOSELY RELATED TO WZ SAGITTAE?

IO Del was discovered by Richter (1970) as a probable U Geminorum star. Subsequently many new plates were taken and the object could now be observed on 212 plates of the Sonneberg 400/1600mm and 400/2000mm astrographs with plate limits of about $17^m...18^m$ and on 160 plates of the 170/1400mm astrograph with plate limits of about $16^m...17^m$. The distribution over the years is uneven. In Table 1 the first columns give the years, the second and third columns the numbers of plates of the 400mm and 170mm astrographs, respectively.

The 1966 eruption published by Richter (1970) could be confirmed. In addition, on two plates taken in 1940 Aug. 2 and Aug. 3 there appear to be, scarcely visible and possibly even simulated by plate faults, traces of the object very close to the plate limit. If the traces are real, we may interpret the object as a dwarf nova with a cycle length of $26/n$ years, where n is a very small integer.

Table 2 gives the outburst observations and Figure 1 the 1966 light-curve.

Invisible on the Palomar Sky Atlas; minimum brightness fainter than 20^m.

Unfortunately neither the rise to maximum nor the maximum itself were observed. Interestingly, during the decline the observations settle down on a plateau of about $17^m\!.3$.

Table 1. Distribution of plate numbers over the years (see the text)

1928	0	2	1944	0	0	1960	3	7	1977	1	0
1929	0	27	1945	0	0	1961	0	2	1978	2	0
1930	0	9	1946	0	0	1962	0	12	1979	3	0
1931	0	13	1947	0	0	1963	31	0	1980	0	0
1932	0	5	1948	0	1	1964	3	4	1981	1	0
1933	0	6	1949	0	3	1965	3	2	1982	1	0
1934	0	10	1950	0	3	1966	6	3	1983	8	0
1935	0	3	1951	0	0	1967	3	3	1984	2	0
1936	0	0	1952	0	0	1968	4	2	1985	5	0
1937	0	0	1953	0	2	1969	16	0	1986	9	0
1938	0	0	1954	0	4	1970	0	0	1987	0	0
1939	0	0	1955	0	15	1971	0	0	1988	13	0
1940	22	0	1956	0	4	1972	0	0	1989	8	0
1941	0	0	1957	0	4	1973	6	0	1990	9	0
1942	29	0	1958	0	8	1974	1	0	1991	3	0
1943	0	0	1959	0	6	1975	4	0	1992	11	0
						1976	1	0	1993	4	0

Table 2. The probable 1940 and the 1966 outbursts

J.D.	m_{pg}	J.D.	m_{pg}
2429 791.482	[17.5	2439 349.479	[17
844.499	[17	378.413	16.2
844.526	18.1: :(?)	378.486	16.1
845.497	18.2: :(?)	380.364	16.8:
		380.412	17.0
		381.365	16.9
		385.447	17.3
		388.346	17.3
		406.293	[16?(plate def.)
		683.507	[17.5
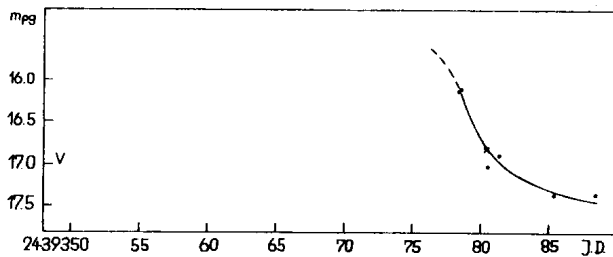
Figure 1. The 1966 outburst, of IO Delphini

Such a plateau is a characteristic feature of SU Ursae Maioris stars shortly before the final decline. In very long-cyclic objects of cycle length >1 year, which are often called WZ Sagittae stars, this plateau drops off about 19...25 days after and down to 2...3 mag below brightness maximum (UZ Boo, WX Cet, AL Com, DV Dra, V592 Her, and WZ Sge, see Figures 2-7 in Richter, 1992). If this interpretation is correct, the brightness maximum of IO Del should have occurred between about J.D.2439365 and J.D.2439370 at a maximum brightness of about 14^m5... 15^m. With a characteristic amplitude of about 8...9 mag the minimum light should be expected at magnitude of $23^m \pm 1^m$.

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NEAR-INFRARED PHOTOMETRY FOR
THE Be STAR MX Per

MX Per (48 Per, HD 25940, B3Vpe, Vsini=215 km/s, M_v=4.02) is one of the most re-
markable Be stars. Both photometric and spectroscopic variations (Jackisch, 1963 and
Baliunas et al., 1975) have been reported. We started our near-infrared photometry in
1989 (Guo et al., 1991). Later, in order to investigate the activity and variability of its
shell, differential near-infrared photometric observations were carried out in December
1991, January 1992, and December 1993 using the 1.26m infrared telescope at the Beijing
Astronomical Observatory. To get the extinction coefficients and the zero-point of the
instrument, two infrared photometric standard stars BS 1140 and BS 1641, were used.
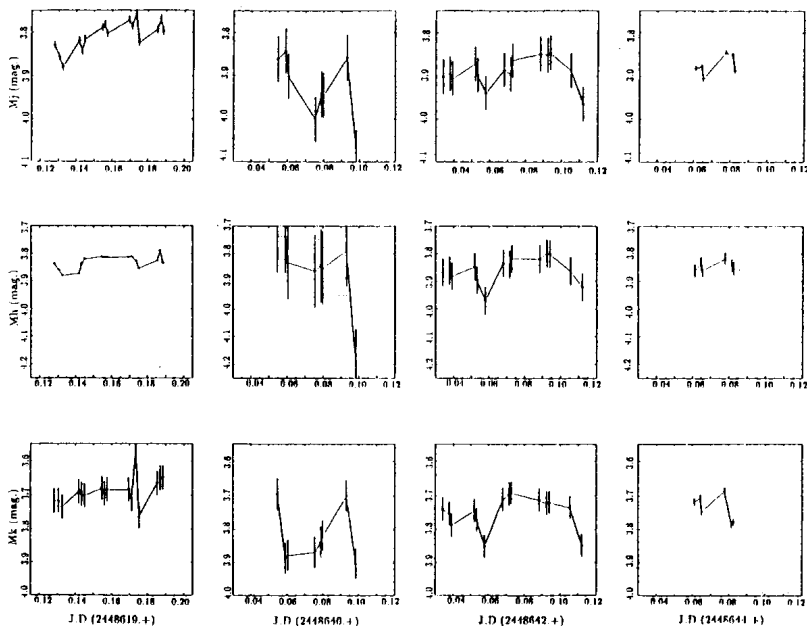
Figure 1. The near infrared photometric results of the peculiar
Be star 48 Per in 1991 and 1992
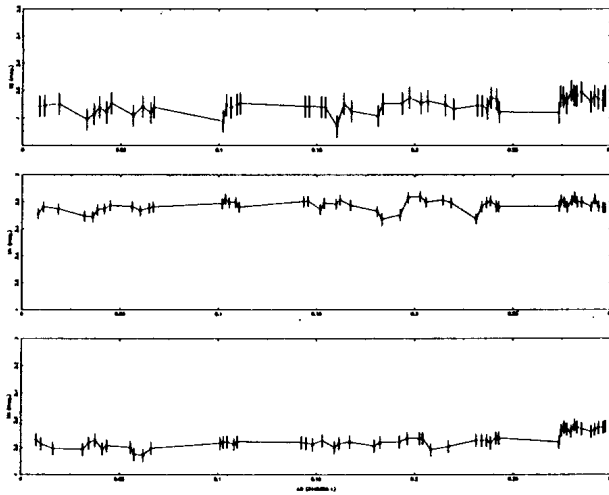
Figure 2. The near infrared photometric results
of the peculiar Be star 48 Per in 1993

Along with MX Per, BS 1140 and BS 1641 were observed many times during the same night. Extinction corrections and transformation into the standard photometric system were performed by using a special software for infrared photometry. The error bars in the Figures represent realistic estimates of observational error.

Our observational results are shown in Figures 1 and 2. It is seen that there were significant rapid variations from 1991 to 1993. As an interpretation, we think that the ionized gas of the circumstellar shell of MX Per was active during our observing run. In order to better understand the character of these variations we should continue to observe the star both in the optical and the infrared.

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RAPID SPECTRAL VARIATIONS OF
THE Be STAR γ Cas

Spectroscopic observations of the Be star γ Cas were carried out on November 5 and 6, 1992. The purpose was to study the relations between the Be phenomena in the gaseous circumstellar disk and the activity of the central star. The spectroscopic observations were made with the French ISIS spectograph fibre-feeded from the 2.16m telescope at Xinglong station of Beijing Observatory (Felenbok and Guerin, 1988). The detector is a Thomson red sensitive CCD with 576×384 pixels. By using a 600 grooves mm^{-1} grating in second order we get a reciprocal dispersion of 2.7 Å mm^{-1} in the Hα region. Total of 13 profiles were obtained. The data were reduced using the MIDAS image processing software on a Sun 4 station computer of Beijing observatory. The spectral scans for the Hα and HeI 6678 region of γ Cas are shown in Figures 1 and 2, respectively. The Hα emission displayed a triangular profile skewed to the red. From Tables 1 and 2 we see that the Hα emission seems to show rapid fluctuations in equivalent width on a timescales of about 45 minutes, and the spectral scans of the HeI 6678 region have lower signal-to-noise ratio due to greater zenith distance and shorter exposure time. Nevertheless, rapid variations of HeI 6678 in equivalent with can also be seen. In addition, from Figure 3 it is clear that there is a systematic trend of red shift in the Hα profiles.

We suggest that the rapid variations of the HeI 6678 may be attributed primarily to photospheric activity, while the changes in Hα may indicate that some material in the envelope was falling back onto the central star at the time of our observations.

Table 1. The results of the measurement of Hα for γ Cas

No.	observing date	exposure time (min.)	Equivalent width (Å)	V/R
1	5 Nov. 1992	20	−17.280	1.121
2	5 Nov. 1992	15	−17.502	1.167
3	5 Nov. 1992	20	−17.621	1.164
4	6 Nov. 1992	20	−17.810	1.139
5	6 Nov. 1992	20	−16.710	1.157
6	6 Nov. 1992	25	−16.614	1.176
7	6 Nov. 1992	25	−17.104	1.152
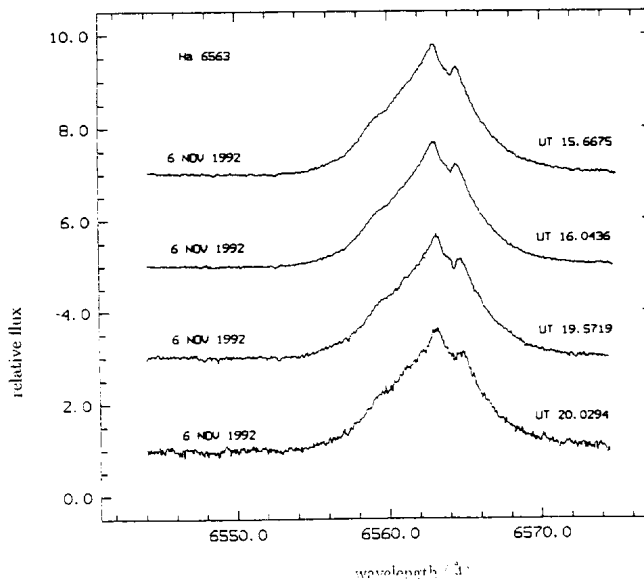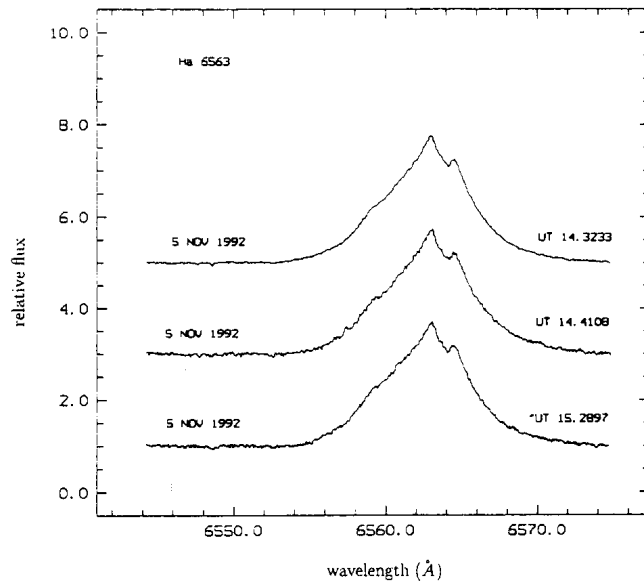
Figure 1. Spectral scans of γ Cas in Hα region
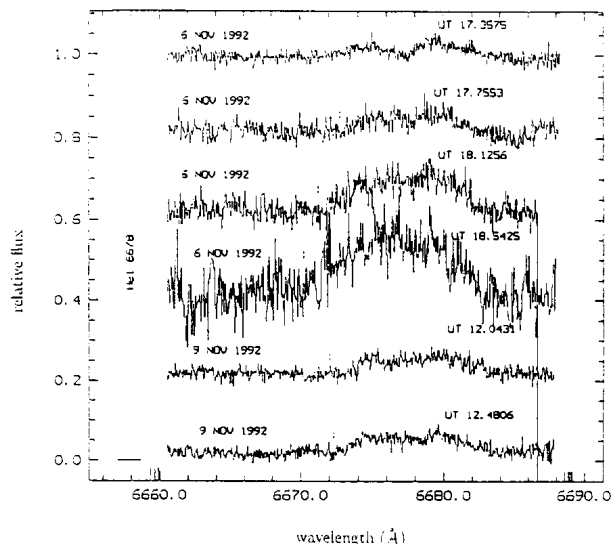
Figure 2. Spectral scans of γ Cas in HeIλ6678 region
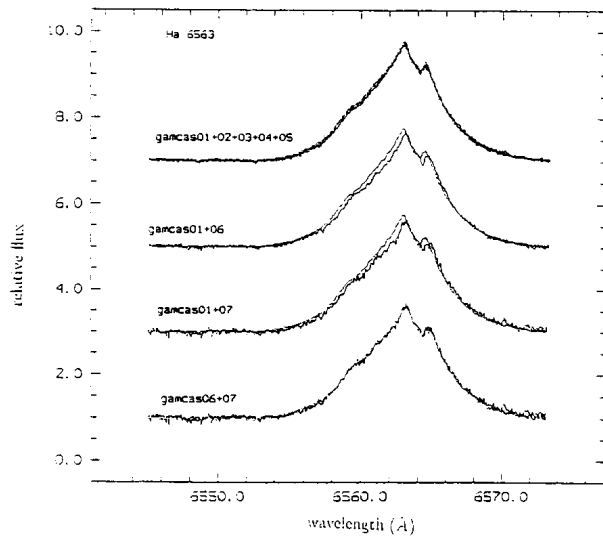
Figure 3. The red shifts of Hα profile of γ Cas

Table 2. The results of the EW measurement of HeI 6678 for γ Cas

No.	observing date	exposure time (min.)	Equivalent width (Å)
1	6 Nov. 1992	20	−0.170
2	6 Nov. 1992	20	−0.212
3	6 Nov. 1992	20	−0.405
4	6 Nov. 1992	20	−0.996
5	9 Nov. 1992	20	−0.255
6	9 Nov. 1992	20	−0.169

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UBV LIGHT CURVE OF RT And FOR 1992

The continuation of a long term project of photometry of the short period RS CVn system RT And is reported here.

Photometric observations for this star have been given previously by several investigators listed by Dapergolas et al. (1988, 1991, 1992).

The star was observed photometrically for a total of 3 nights with the 1.2m Kryonerion telescope from 23 to 27 Aug. 1992 using a single channel photon counting photometer described by Dapergolas & Korakitis (1987). The photometer employs a high gain 9789QB phototube and conventional UBV filters. Its output is fed directly to a microcomputer enabling rapid data access.

The data reduction method is the standard one. Comparison and check stars are BD +52°3384 and BD +52°3377 respectively and the accuracy of the observations presented here is ±0.015 mag for V and B and ±0.025 for U.

Table 1 lists the dates of observations and the corresponding phases covered.

The derived light curves for U, B, V colours are illustrated in Figure 1.

Table 1

Date	Phase
23 August 1992	.13—.59
26 August 1992	.92—.36
27 August 1992	.48—.96

RT And Aug. 1992

Figure 1

2

RT And (V)

Delta Magnitude=(RT And)-(BD+52° 3384)

Figure 2

RT And (B)

Delta Magnitude=(RT And)-(BD+52° 3384)
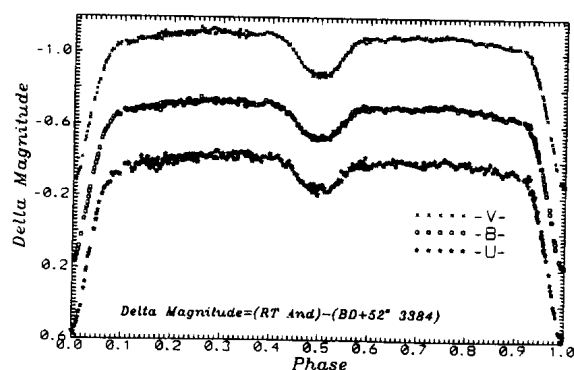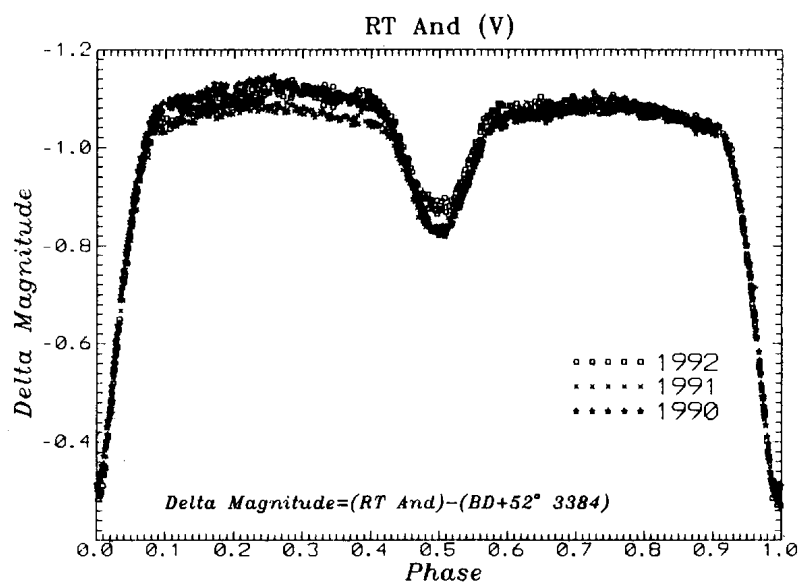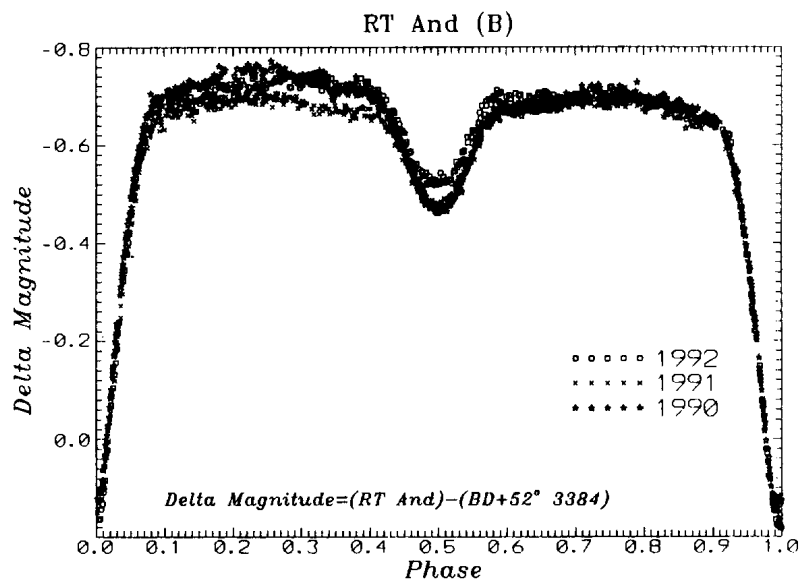
Figure 3

Table 2

Date	Type	V		B		U	
		J.D. Hel. 2440000+	O−C phase	J.D. Hel. 2440000+	O−C phase	J.D. Hel. 2440000+	O−C phase
23 Aug. 1992	II	8858.5388 ±0.0004	0.499	8858.5396 ±0.0004	0.500	8858.5408 ±0.0007	0.502
26 Aug. 1992	I	8861.3684 ±0.0001	0.998	8861.3686 ±0.0001	0.998	8861.3687 ±0.0001	0.998

In Table 2 the times of minima and the O−C values are listed for the V, B and U bands respectively. Times of minima are calculated using the method described by Kwee and van Woerden (1956) whereas the O−C values were determined from the linear ephemeris

$$T=2441141.88902+0\overset{d}{.}628929513\times E$$

given by Kholopov (1982).

From Figure 1 it can be seen that the light curves show asymmetry in the secondary minima that gets larger towards shorter wavelengths.

The variability in the levels of maxima noticed previously by Mancuso et al. (1979). Dapergolas et al. (1988, 1991, 1992) is also present here (see Figures 2 and 3), where the light curves for the years 1990, 1991 and 1992 in V and B are superimposed. This variability is probably due to a photospheric activity of the system as it is assumed by Dapergolas et al. (1988, 1991, 1992), Zeilik et al. (1989) and Gordon et al. (1990). This activity derived from the distortion in the light curve outside the eclipse is probably due to the presence of dark spots on the surface of the active star.

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IMPROVED ASTROMETRY FOR VARIABLE STARS

In the course of preparing finder charts for variable
stars, I have used the HST Guide Star Catalogue extensively as
a source of reliable positions. Many of the variables I have
charted since 1990 are found in the GSC, and a list of forty
stars is presented, as Table 1. The positions are all taken
from the GSC. In the case of multiple GSC positions, the mean
value is given. All stars have been identified by reference to
photographs or older charts.

Several very interesting variables are not in the GSC,
and improved positions have been measured from photographs,
relative to GSC stars. Data for five stars are in Table 2.

Clarifying remarks are given below for four stars.

TZ Cen.
The star GSC 8989-00095 agrees well with TZ Cen as regards
position and magnitude. There appears to be no identification
problem, contrary to the remark given in the GCVS.

NSV 14319. Near S5150 = RZ Gruis.
The position given in the NSV is spurious, as none was given
in the paper by Siedel (1957), and the finder chart in that
paper appears to have been misinterpreted (Wenzel, 1990). The
star is also wrongly plotted on VSS, RASNZ chart 954 (Bateson
and Morel,1990). The variable is really 2' south of the marked
position. Following the advice given by Wenzel, I find that
NSV 14319 = GSC 8010-00313 (m=12.23). Position in Table 1.
[Note that Siedel's finder chart has North at top, in error.
'N' should be at bottom.]

NSV 4223 Pyx.
Se star. Observed by P.Camilleri on patrol films. In Catalogue
of Galactic S Stars (Stephenson 1984), which places it 1.5 arc
min south-following CoD-32°5649 (9.7). Both stars are clearly
seen on Union Obs. chart, with NSV 4223 near maximum (10 mag).
NSV 4223 is not in DM catalogues, nor in GSC. Contrary to NSV,
and the Catalogue of S Stars, NSV 4223 ≠ CoD-32°5649.

New Variable in Vulpecula. See IBVS 3604.
This variable is superimposed on the planetary nebula M27, a
popular subject for astrophotography. Many photos in popular
books and magazines were searched for images of the variable.
One such photo is in Sky & Tel., Aug. 1993, p.66, where the
variable is at about 14.3V. A mean position was determined
relative to GSC stars (two determinations using different sets
of stars). The improved position appears in Table 2.

Table 1: Positions of Variable Stars from Guide Star Catalogue.

Name		GSC No.	R.A. (J2000)			Dec.			Remarks
			h	m	s	o	'	"	
WW	Cet	5263-00415	0	11	24.81	- 11	28	42.9	
R	For	6433-00295	2	29	15.28	- 26	5	54.5	
R	Ret	8872-00420	4	33	32.82	- 63	1	46.2	
TV	Col	7059-00509	5	29	25.47	- 32	49	4.2	
ST	Pup	7100-00288	6	48	56.36	- 37	16	33.9	
Z	CMa	5389-01211	7	3	43.07	- 11	33	5.7	
QS	Mon	5396-00840	7	25	13.06	- 7	52	42.7	
V694	Mon	5396-01135	7	25	51.24	- 7	44	7.6	
DQ	Pup	6542-00396	7	29	11.16	- 26	10	32.1	
PP	Pup	8133-02109	7	35	52.28	- 46	32	17.0	
YZ	CMi	0183-02190	7	44	40.50	+ 3	33	15.3	
SS	Pup	6548-02718	7	46	38.29	- 26	20	35.4	
ET	Pup	6561-01413	7	54	37.20	- 28	4	58.6	
R	Cha	9394-01962	8	21	46.91	- 76	21	18.5	
W	Cha	9394-02775	8	28	22.17	- 76	33	43.1	
V336	Car	8576-00085	8	32	25.23	- 57	2	14.2	
TX	Pyx	7141-00233	8	42	30.62	- 32	20	32.2	
AM	Car	8943-03285	10	14	29.40	- 60	43	27.9	
FU	Car	8626-02521	10	41	0.34	- 59	23	12.9	
V426	Car	8626-00464	10	47	56.89	- 59	8	54.7	
V432	Car	8959-00431	11	8	40.30	- 60	42	51.7	
FQ	Car	8959-00065	11	10	13.00	- 60	50	50.7	
U	Cen	8650-01846	12	33	30.63	- 54	39	34.5	
EX	Hya	6709-00694	12	52	24.42	- 29	14	56.7	
V496	Cen	8989-01422	13	3	10.76	- 60	52	38.9	
TZ	Cen	8989-00095	13	4	7.24	- 60	45	57.5	
V398	Cen	8990-03516	13	19	55.17	- 60	42	26.8	
NSV 6200		8990-03462	13	21	37.61	- 61	34	14.9	
NSV 6202		8990-02176	13	21	42.89	- 60	49	46.4	
RZ	Vir	0300-00285	13	21	50.40	+ 1	50	49.9	
U	Mus	8998-02133	13	25	3.34	- 64	39	47.8	
XY	Mus	8999-02850	13	27	33.09	- 65	4	3.0	
NSV 6282		8666-00587	13	31	5.25	- 55	0	0.6	
BV	Cen	8666-00998	13	31	19.52	- 54	58	33.7	
BC	Cen	8677-01439	14	2	29.30	- 58	33	25.0	
NSV 6525		9013-00792	14	3	22.95	- 63	57	28.7	
NSV 6536		9013-00637	14	5	33.59	- 64	20	1.0	
NSV 6545		9009-01513	14	6	0.09	- 62	4	22.6	
Z	Aps	9252-01914	14	6	54.98	- 71	22	16.2	
V854	Cen	7810-00220	14	34	49.35	- 39	33	19.8	
NSV 7190		9034-00653	15	42	25.79	- 65	39	8.5	
HK	TrA	9034-03378	15	42	30.92	- 65	38	47.6	
GL	TrA	9031-03143	15	43	27.51	- 65	27	29.7	
AF	Nor	8705-03082	15	52	38.05	- 56	38	31.4	
SS	Nor	8723-00573	16	13	21.89	- 59	46	56.6	Near QR Nor.
TX	Oph	0406-00580	17	4	0.10	+ 4	59	1.1	
AE	Ara	8347-01978	17	41	4.93	- 47	3	27.0	
V2203	Oph	0424-00304	17	49	43.32	+ 4	28	24.4	
AR	Pav	9080-00788	18	20	27.92	- 66	4	41.8	
GU	Sgr	6844-03878	18	24	15.58	- 24	15	26.1	
V4018	Sgr	6869-00806	18	25	26.95	- 28	35	57.5	
NSV 11753		3132-00900	19	6	54.38	+ 44	2	55.5	

Table 1 (continued):

Name		GSC No.	R.A.	(J2000)		Dec.		Remarks
			h m s		o	′	″	
KQ	Aql	0463-01244	19 12 22.87	+	1	33	8.6	
HR	Del	1642-00998	20 42 20.38	+	19	9	39.9	
LQ	Del	1642-00526	20 42 49.47	+	19	11	7.7	
EV	Aqr	0526-01562	21 6 17.85	+	0	52	43.5	
U	PsA	6960-00988	22 2 29.49	−	27	53	7.0	
S	PsA	6960-01450	22 3 45.82	−	28	3	4.0	
RU	Peg	1145-00536	22 14 2.58	+	12	42	11.4	
NSV 14319		8010-00313	22 48 16.47	−	42	54	22.7	

Table 2: Positions of Variable Stars not in Guide Star Catalogue.

Name		GSC No.	R.A.	(J2000)		Dec.		Remarks
			h m s		o	′	″	
NSV 4223		....	8 43 41.0	−	32	31	40	CGSS 543.
TT	Cen	....	13 19 35.5	−	60	46	45	
UU	Cen	....	13 22 6.4	−	61	18	37.4	
QR	Nor	....	16 13 20.0	−	59	47	30	Near SS Nor.
...	Vul	....	19 59 29.8	+	22	45	13	Near M27.

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CALL FOR OBSERVATIONS OF BH Cas

Observations of BH Cas were collected on 19 February 1994 from the Steward Observatory 0.91-meter telescope on Kitt Peak. Nine frames were obtained over a period of ~ 1.3 hours using a Tektronics 2048 × 2048 CCD (no filter). The IRAF routine *imexamine* was used to gather the background-subtracted fluxes of BH Cas and of the reference and check stars, GSC 01629 and GSC 01134 respectively. The data is given in Table I.

Table I : Flux Values

UT	BH Cas	GSC 01629	GSC 01134
02:48:40	265568	121795	96509
02:59:24	262178	118351	93634
03:08:06	265406	116603	93170
03:17:21	272431	116974	93379
03:25:54	280967	118128	93628
03:33:31	270747	113479	90062
03:44:07	281462	116563	92990
03:52:19	268233	111837	88710
04:05:38	262414	108613	86909

Plots of flux ratio against time were made in order to detect any possible variation in the brightness of BH Cas. In Figure 1 the ratio of the flux of BH Cas to that of the reference star is shown; in Figure 2 the ratio of the flux of the reference star to that of the check star is shown. Both figures are plotted to the same vertical scale.
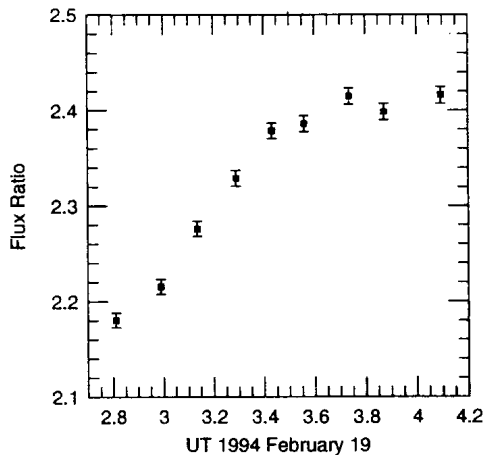
Figure 1. BH Cas/GSC 01629
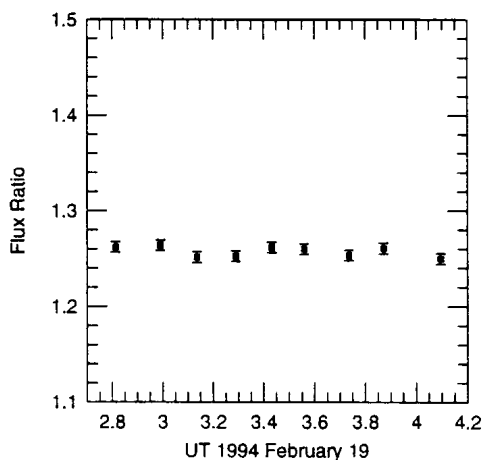
Figure 2. GSC 01629/GSC 01134

The discovery observations of the variability of BH Cas were made by Beljawsky (1931) and were confirmed by Kukarkin (1938) who concluded that the star was possibly of W UMa type with period $\sim 0.^{d}5$ and amplitude $\sim 0.^{m}4$. A later paper by Ahnert and Hoffmeister (1943) concluded that no star in the given area showed variation in brightness. No published observations of BH Cas have appeared since that time until this paper. Although further investigation is necessary, it is questionable whether the conclusion of Ahnert and Hoffmeister is valid.

The presence of a star of appreciable brightness within 10 arcseconds of BH Cas poses a potential problem for accurate photoelectric observations. An attempt will be made to use a CCD with filters designed to produce a standard (U,B,V) response in order to reconstruct the entire light and color curves. Please contact the undersigned for finder charts or additional information.

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TIMES OF LIGHT MAXIMUM OF VZ CANCRI: 1994 SEASON[1]

In a recent paper Arellano Ferro et al. (1994) studied the period variations of the δ Scuti star VZ Cnc and demonstrated that the period has not been steadily increasing as previously believed. The $O - C$ residuals for the last 50 years, before and after being corrected from the beat period effects, show a structure that admits several interpretations: a slopping straight line which implies that the period needs to be revised, two abrupt period changes and, a sinusoidal variation. These authors have speculated that a sinusoidal variation might be produced by light-time effects in a binary system.

Whether the sinusoidal appearance of the $O - C$ residuals will persist in the future, other abrupt period changes will occur, or simply a period revision is needed, will be learned from the systematic obtention of times of maximum light in the years to come.

During March and April 1994 we obtained differential photometry of VZ Cnc through the V filter using the stars BD+10°1818 and BD+10°1816 as comparison and check stars respectively. The observations were obtained with an Optec SSP-5A photoelectric photometer attached to the 0.57m telescope of the La Luz Observatory of the University of Guanajuato.

We report nine observed times of maximum light and the corresponding $O - C$ values in Table 1. We have calculated the $O - C$ residuals using the ephemeris:

$$T_{max} = \text{HJD2431550.71} + 0.17836376E,$$

and then

$$(O - C) = T_{max}(obs) - T_{max}.$$

Since only one more seasons will add very little to the understanding of the period variations of VZ Cnc already discussed by Arellano Ferro et al. (1994), we shall not carry our present discussion any further. However, we emphasize that yearly measurements of times of maximum light of VZ Cnc will contribute substantially to the understanding of the periodic nature of this star. In order to study overall drifts of the light curve and not only the moments of maximum brightness, future observers are encouraged to publish their full sets of observations. In Table 2 we report the V magnitude differences VZ Cnc − BD+10°1818 for our 1994 season.

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[1] Based on observations obtained at the La Luz Observatory of the University of Guanajuato, México.

Table 1. Times of light maximum of VZ Cnc in 1994.

HJD (244 9400.+)	$O-C$ (days)	HJD (244 9400.+)	$O-C$ (days)
17.767	+0.0024	28.638	−0.0068
18.651	−0.0054	33.637	−0.0014
19.733	+0.0064	40.600	+0.0049
20.615	−0.0034	41.661	−0.0043
20.790	−0.0071:		

Table 2. Differential V photometry VZ Cnc − BD+10°1818 in 1994.

HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.
12.6332	1.058	12.8012	1.134	15.7878	0.859	17.6886	1.385	17.8095	1.190
12.6458	1.209	12.8049	1.186	15.7913	0.926	17.6911	1.400	17.8129	1.214
12.6428	1.179	12.8083	1.183	15.7947	0.939	17.6931	1.404	17.8168	1.230
12.6534	1.231	12.8123	1.178	15.7966	0.934	17.6955	1.405	17.8208	1.237
12.6501	1.214	12.8160	1.193	15.7988	0.936	17.6977	1.412	17.8236	1.242
12.6593	1.275	12.8201	1.222	15.8012	0.958	17.7003	1.416	17.8279	1.264
12.6565	1.258	12.8245	1.253	15.8038	0.966	17.7038	1.416	17.8309	1.287
12.6677	1.310	12.8287	1.273	15.8063	1.003	17.7060	1.418	17.8333	1.299
12.6632	1.291	12.8322	1.288	15.8089	0.947	17.7088	1.433		
12.6739	1.322	12.8346	1.298			17.7110	1.450	18.6124	1.378
12.6711	1.314	12.8392	1.316	17.6003	0.913	17.7134	1.449	18.6192	1.366
12.6802	1.375	12.8424	1.325	17.6032	0.925	17.7172	1.448	18.6253	1.271
12.6768	1.364			17.6065	0.934	17.7199	1.442	18.6287	1.209
12.6856	1.378	15.7095	1.349	17.6105	0.958	17.7234	1.431	18.6343	1.104
12.6831	1.374	15.7128	1.340	17.6133	0.991	17.7285	1.376	18.6380	1.053
12.6922	1.377	15.7162	1.350	17.6162	1.006	17.7319	1.346	18.6415	1.011
12.6888	1.373	15.7194	1.383	17.6197	1.011	17.7352	1.300	18.6458	0.948
12.6986	1.405	15.7233	1.390	17.6222	1.028	17.7385	1.247	18.6533	0.952
12.6956	1.398	15.7258	1.376	17.6260	1.060	17.7429	1.171	18.6566	0.952
12.7024	1.413	15.7289	1.353	17.6292	1.087	17.7452	1.120	18.6602	0.988
12.7003	1.409	15.7321	1.349	17.6330	1.117	17.7482	1.028	18.6638	1.020
12.7078	1.412	15.7363	1.374	17.6367	1.147	17.7509	0.967	18.6726	1.078
12.7052	1.414	15.7388	1.369	17.6402	1.163	17.7535	0.873	18.6756	1.103
12.7131	1.415	15.7415	1.363	17.6438	1.186	17.7555	0.803	18.7229	1.269
12.7108	1.405	15.7444	1.371	17.6475	1.212	17.7579	0.782	18.7290	1.301
12.7188	1.421	15.7471	1.366	17.6505	1.234	17.7601	0.760	18.7324	1.304
12.7158	1.421	15.7495	1.370	17.6533	1.254	17.7640	0.771	18.7354	1.297
12.7245	1.432	15.7518	1.368	17.6558	1.260	17.7668	0.771	18.7397	1.303
12.7219	1.443	15.7543	1.353	17.6588	1.275	17.7693	0.794	18.7504	1.315
12.7299	1.381	15.7563	1.351	17.6623	1.307	17.7720	0.821	18.7527	1.316
12.7270	1.422	15.7594	1.364	17.6648	1.322	17.7747	0.850	18.7558	1.317
12.7304	1.394	15.7621	1.362	17.6668	1.327	17.7790	0.900	18.7579	1.320
12.7330	1.393	15.7647	1.321	17.6691	1.329	17.7819	0.941	18.7606	1.325
12.7362	1.358	15.7671	1.264	17.6720	1.333	17.7848	0.974	18.7632	1.332
12.7394	1.298	15.7699	1.228	17.6748	1.340	17.7879	1.004	18.7655	1.338
12.7838	0.899	15.7722	1.221	17.6770	1.349	17.7913	1.036	18.7677	1.341
12.7879	0.957	15.7754	1.157	17.6793	1.353	17.7947	1.063	18.7715	1.350
12.7911	1.004	15.7775	1.095	17.6816	1.364	17.7992	1.111	18.7741	1.364
12.7947	1.057	15.7797	1.047	17.6839	1.379	17.8026	1.145	18.7779	1.380
12.7973	1.085	15.7833	0.903	17.6863	1.380	17.8063	1.172	18.7811	1.378

Table 2. Continued

HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.
18.7847	1.370	19.7291	0.922	20.6741	1.246	28.6040	1.370	33.6344	0.857
18.7868	1.371	19.7316	0.903	20.6765	1.255	28.6065	1.350	33.6379	0.881
18.7924	1.379	19.7337	0.906	20.6786	1.269	28.6092	1.329	33.6398	0.898
18.7952	1.359	19.7367	0.908	20.6841	1.302	28.6116	1.312	33.6428	0.925
18.7974	1.353	19.7410	0.913	20.6877	1.325	28.6136	1.286	33.6460	0.950
18.8009	1.341	19.7462	0.932	20.6901	1.318	28.6163	1.251	33.6504	0.991
18.8030	1.321	19.7511	0.966	20.6920	1.314	28.6187	1.198	33.6531	1.012
18.8060	1.297	19.7542	0.980	20.6947	1.330	28.6210	1.152		
18.8099	1.274	19.7590	1.015	20.6976	1.337	28.6242	1.079	40.6563	1.053
		19.7623	1.042	20.6999	1.340	28.6281	0.986	40.6589	1.086
19.5966	1.175	19.7694	1.086	20.7026	1.352	28.6342	0.915	40.6636	1.120
19.5990	1.173	19.7764	1.128	20.7050	1.362	28.6374	0.883	40.6698	1.170
19.6023	1.176	19.7791	1.151	20.7073	1.361	28.6456	0.921	40.6824	1.251
19.6047	1.179	19.7816	1.168	20.7098	1.358	28.6480	0.929	40.6854	1.274
19.6073	1.190	19.7850	1.178	20.7131	1.372	28.6551	1.005	40.5981	0.797
19.6102	1.202	19.7885	1.202	20.7166	1.381	28.6572	1.027	40.6005	0.791
19.6120	1.205	19.7909	1.225	20.7249	1.361	28.6606	1.054	40.6037	0.814
19.6140	1.211	19.7937	1.238	20.7223	1.368	28.6645	1.085	40.6066	0.828
19.6230	1.252	19.7967	1.251	20.7309	1.380	28.6679	1.116	40.6098	0.847
19.6299	1.276	19.7998	1.277	20.7278	1.377	28.6708	1.146	40.6121	0.871
19.6439	1.335	19.8036	1.297	20.7401	1.400	28.6739	1.173	40.6156	0.929
19.6460	1.345	19.8063	1.310	20.7362	1.405	28.6768	1.188	40.6178	0.957
19.6485	1.349	19.8106	1.335	20.7473	1.388	28.6798	1.192	40.6236	1.013
19.6507	1.349	19.8129	1.330	20.7440	1.395	28.6822	1.205	40.6261	1.033
19.6534	1.380	19.8157	1.311	20.7542	1.365	28.6853	1.225	40.6284	1.050
19.6565	1.411	19.8183	1.323	20.7508	1.376	28.6879	1.239	40.6305	1.068
19.6590	1.398			20.7615	1.331	28.6906	1.249	40.6342	1.112
19.6625	1.378	20.6065	0.911	20.7585	1.382	28.6934	1.249	40.6366	1.141
19.6651	1.399	20.6082	0.856	20.7685	1.217	28.6963	1.250	40.6417	1.173
19.6675	1.420	20.6106	0.813	20.7652	1.272	28.6989	1.255	40.6444	1.182
19.6701	1.413	20.6126	0.769	20.7733	1.142	28.7018	1.260	40.6472	1.194
19.6720	1.413	20.6152	0.765	20.7707	1.193	28.7049	1.260	40.6553	1.256
19.6761	1.413	20.6178	0.765	20.7783	1.033	28.7077	1.261	40.6526	1.247
19.6803	1.415	20.6207	0.783	20.7759	1.081	28.7106	1.274	40.6643	1.297
19.6832	1.422	20.6236	0.804	20.7833	0.964	28.7128	1.287	40.6624	1.285
19.6881	1.422	20.6261	0.837	20.7809	0.972	28.7158	1.271	40.6718	1.325
19.6918	1.396	20.6279	0.858	20.7888	0.852	28.7201	1.256	40.6682	1.321
19.6958	1.363	20.6306	0.879	20.7864	0.855	28.7243	1.293	40.6798	1.362
19.6986	1.344	20.6328	0.900	20.7943	0.946	28.7273	1.325	40.6770	1.354
19.7011	1.329	20.6358	0.931	20.7918	0.928	28.7304	1.338	40.6877	1.370
19.7043	1.282	20.6378	0.953	20.7996	0.965	28.7344	1.329	40.6835	1.362
19.7064	1.247	20.6411	0.993	20.7975	0.938	28.7380	1.324	40.6945	1.381
19.7088	1.212	20.6449	1.034	20.8046	1.010			40.6910	1.374
19.7112	1.183	20.6500	1.083	20.8026	0.997	33.6163	1.140	40.7006	1.400
19.7133	1.151	20.6536	1.118	20.8098	1.059	33.6189	1.081	40.6981	1.392
19.7161	1.105	20.6566	1.144	20.8074	1.029	33.6217	1.004	40.7077	1.412
19.7188	1.057	20.6601	1.174	20.8157	1.099	33.6233	0.962	40.7036	1.407
19.7211	1.020	20.6653	1.211			33.6264	0.929	40.7310	1.384
19.7241	0.973	20.6684	1.219	28.5987	1.392	33.6291	0.893	40.7419	1.310
19.7264	0.940	20.6715	1.230	28.6013	1.386	33.6322	0.872	40.7387	1.363

HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.	HJD 2449400.+	ΔV mag.
40.7536	1.062	41.6624	1.029	50.5979	0.863	50.6776	1.325	68.6464	1.208
40.7462	1.239	41.6655	1.043	50.6005	0.875	50.6802	1.340	68.6499	1.218
40.7634	0.828	41.6676	1.053	50.6031	0.886	50.6832	1.380	68.6563	1.247
		41.6719	1.062	50.6060	0.929	50.6855	1.384		
41.5943	1.355	41.6751	1.077	50.6086	0.951	50.6887	1.395	69.6002	1.361
41.5970	1.359	41.6778	1.097	50.6117	0.973	50.6911	1.407	69.6022	1.367
41.6002	1.360	41.6816	1.115	50.6141	0.996	50.6941	1.392	69.6048	1.371
41.6041	1.370	41.6843	1.123	50.6170	0.995	50.6962	1.379	69.6074	1.365
41.6088	1.379	41.6868	1.139	50.6189	1.019	50.6992	1.378	69.6103	1.365
41.6110	1.376	41.6917	1.172	50.6215	1.060	50.7026	1.380	69.6131	1.383
41.6141	1.372	41.6951	1.194	50.6239	1.082	50.7062	1.399	69.6155	1.398
41.6164	1.375	41.6982	1.206	50.6267	1.124	50.7085	1.402	69.6185	1.402
41.6196	1.370	41.7015	1.210	50.6288	1.140	50.7112	1.399	69.6211	1.398
41.6222	1.360	41.7049	1.207	50.6349	1.147	50.7139	1.391	69.6234	1.401
41.6266	1.333	41.7069	1.208	50.6374	1.173	50.7167	1.374	69.6273	1.386
41.6284	1.326	41.7106	1.213	50.6401	1.197	50.7193	1.370	69.6300	1.379
41.6322	1.296	41.7137	1.212	50.6424	1.205			69.6348	1.333
41.6350	1.274	41.7183	1.217	50.6447	1.223	68.6098	0.859	69.6371	1.313
41.6389	1.226	41.7231	1.227	50.6475	1.222	68.6124	0.890	69.6403	1.292
41.6412	1.198	41.7316	1.255	50.6505	1.229	68.6159	0.930	69.6426	1.274
41.6437	1.177	41.7347	1.254	50.6530	1.272	68.6183	0.944	69.6453	1.257
41.6463	1.150	41.7380	1.244	50.6563	1.288	68.6210	0.979	69.6491	1.225
41.6494	1.112	41.7412	1.244	50.6584	1.289	68.6244	1.032	69.6515	1.192
41.6519	1.084	41.7458	1.260	50.6652	1.362	68.6285	1.058	69.6545	1.154
41.6551	1.063	41.7491	1.267	50.6683	1.386	68.6316	1.091	69.6348	1.333
41.6569	1.045			50.6721	1.353	68.6370	1.155		
41.6605	1.033	50.5956	0.844	50.6750	1.335	68.6390	1.173		

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Arellano Ferro, A., Nuñez, N.S. and Avila, J.J., 1994, PASP, in press (July issue)

NON-CEPHEID CHARACTER OF V588 Cas

V588 Cas (RA=$1^h19^m12^s$, Dec=+54°6', 1950.0) is listed in the 4th Edition of the GCVS as "DCEP:" with no period or epoch given. The magnitude range is listed as $12^m.2$-$13^m.6$ (photographic). We observed V588 Cas during January–March in 1992 and 1993, included in our list of Cepheids thought to have few or no recent observations. We found no indication of a Cepheid light curve.

The GCVS lists a reference for a finder chart (Hoffmeister, 1957), which has been reproduced in Figure 1. Although no chart on the No. 291 page is labelled as V588 Cas, we recognize the field, in comparison with our CCD images (our telescopes point to 30" or better). The MVS chart is labelled "S3880 Cas".

A printout of one of our R-bandpass CCD images is shown in Figure 2, for comparison with Figure 1. Our field of view in this image is about 5 arc minutes. We have assigned arbitrary star numbers and the variable marked in the MVS is #1 on our diagram. Agreement of our field with this MVS chart is not in doubt.

We obtained CCD observations during the 1992 and 1993 observing seasons to check the light curve of this star. We used two similar telescopes and CCD equipment, at two sites. RHB obtained observations with the U.S. Air Force Academy's 0.4 m DFM Engineering reflector, and a 14-bit Photometrics (LN$_2$-cooled) CCD system. DLD obtained observations with Virginia Military Institute's 0.5 m DFM Engineering reflector, and a 14-bit Photometrics (Peltier-cooled) CCD system.

Observations were obtained in the Johnson V and R bandpasses, with a field of view of 12', and 5', respectively, for the two systems. Standard flat field corrections were applied to all V588 Cas images. We obtained images of the standard field in M67 (Schild, 1983), to insure that our detector/filter system was close to the standard Johnson system. We
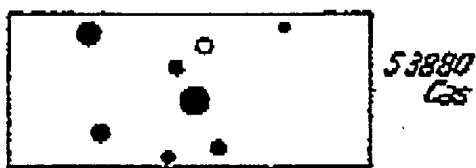

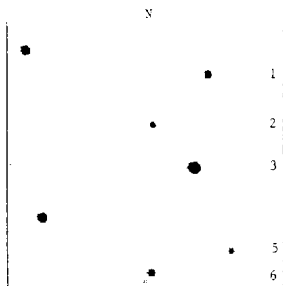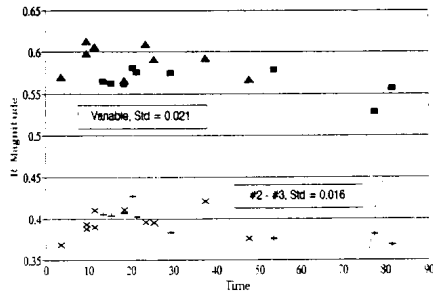Figure 1   Figure 2

Figure 3. Light curve of V588 Cas (1993 data)

used DAOPHOT (VMI) or rectangular aperture photometry (USAFA) to obtain magnitudes from the corrected CCD images. Observations were entered into a spreadsheet, with comparison star differences tabulated to help insure that any errors would be noticed.

Unlike the other Cepheids observed, we found that V588 Cas does not show any indication of a Cepheid light curve. In Figure 3 is shown our differential R bandpass CCD observations of V588 Cas, referenced to the average magnitude of comparison stars #2 and #3 (squares=VMI data, triangles=USAFA data). In the bottom half of the graph is shown magnitude differences of comparison stars #2 and #3 (with an offset to place the difference conveniently on the graph), as an indication of the variability and observational noise in these comparison stars. We found that the average of our comparison star differences (VMI−USAFA) showed an $0.^{m}031$ difference, and we added that amount to one set to insure no systematic differences; that difference might be attributed to the different manner of obtaining magnitudes.

The standard deviation of the differences (shown on the graph) of the comparison stars (#2 minus #3) is $0.^{m}016$. For the variable minus the average of the two comparison stars, the standard deviation is $0.^{m}021$. The variation in the variable star is comparable to that in the comparison stars. Although only our 1993 results are shown, we obtained similar results with the 1992 data.

We examined the surrounding stars out to about 4' (radius) for variability above the $0.^{m}1$ level, and found none. The CCD photometry, using images, greatly reduces the risk of misidentification. We conclude that the star denoted as V588 Cas is not a Cepheid.

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PHOTOELECTRIC PHOTOMETRY OF VW CEPHEI IN 1993

VW Cephei (HD 197433; BD +75°752) is a short period (P=$0\overset{d}{.}27831347$), W Ursae Majoris-type eclipsing binary with components of spectral types G5V+K0V. VW Cep has been monitored at the Villanova University Observatory since 1978. Asymmetries in the light curve have been interpreted as arising from the presence of cool starspots, located chiefly on the photosphere of the larger, more massive component of the system (Bradstreet and Guinan, 1990).

The data were acquired over six nights: July 17, 18, 21, 23, 31, 1993 UT using the 38-cm Cassegrain telescope at the Villanova University Observatory. This telescope is equipped with a photoelectric photometer that uses a refrigerated EMI 9558 photocell. Differential magnitudes were computed from observations made with the intermediate-band Strömgren y filter (λ=5500Å, FWHM=350Å) and in the intermediate-band Hα filter (λ=6585Å, FWHM=280Å). A total of nearly 600 observations were secured in both band-passes. An integration time of 20 seconds was used for each observation. The observing sequence used was the usual sky-comparison-variable-comparison-sky routine; BD +76°809 (m_v=7.6, F2) was the comparison star.

The yellow and red light curves, shown in Figure 1, were formed from the observations using the ephemeris given by Hill (1989):

$$T_{minI} \text{ (HJD)}=\text{HJD } 2437469.3939+0\overset{d}{.}27831347\times E \qquad (1)$$
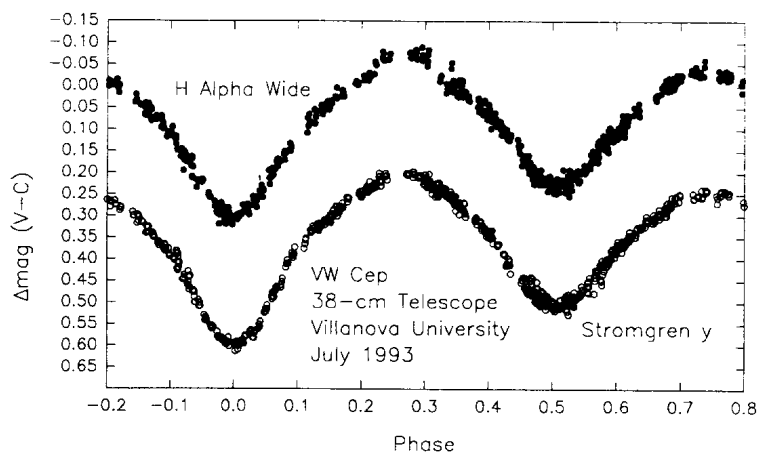$$\pm 7 \qquad \pm 6$$

Figure 1. Yellow and red light curves of VW Cep.

The light levels of the extrema are listed in Table 1. They are given in terms of delta magnitude (variable minus comparison) and are relative to the comparison star.

Table 1

	Yellow $\Delta m(v-c)$	Hα $\Delta m(v-c)$
Primary Minimum	+0.597	+0.303
Maximum I	+0.205	−0.070
Secondary Minimum	+0.506	+0.232
Maximum II	+0.249	−0.031

As shown in Figure 1 and Table I, the light curves are asymmetrical in which the Maximum I (0.25P) is brighter than the corresponding Maximum II (0.75P) by $\cong 0.04$ magnitude in each filter. This is probably due to the presence of spots at the 0.75 phase.

The times of the minimum light were calculated using the nights of July 17 and July 18, 1993 UT, in which the eclipses were completely observed. The times of mid-eclipses were found using a parabolic least squares fit to the data in each filter. Table 2 lists the type of minimum, the time of minimum (times in each filter in terms of heliocentric Julian Date averaged from both filters), the number of cycles elapsed (E), and the (O−C) residual in days from equation 1.

Table 2

		HJD 2449100+	E	(O−C)
Primary	(07/17/93 UT)	85.6369	42097.0	+0$^{\text{d}}$0809
Primary	(07/18/93 UT)	86.7501	42101.0	+0.0808
Secondary	(07/18/93 UT)	86.6141	42100.5	+0.0840

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ON THE STABILITY OF SPOTTED REGIONS ON
STELLAR SURFACES OF WEAK–LINE T TAURI STARS

We undertake a long-term photometric monitoring of a sample of WTTS in the Tau-Aur complex aimed at detecting periodic processes in the light curves of above stars and determining the lifetimes of cool spots on the star's surfaces (Grankin 1992, 1993). Maid-anak UBVR-photometry Data Bank is at Tashkent Astronomical Institute and available to any interested in.

Table 1

HBC #	Name	bo93	gr93	Period (day) other source	This paper	Observ. interval 1900+
29	V410 Tau			1.871 (vr88)	1.872095	86-93
68	VY Tau			5.37 (gr91)	5.36995	85-93
370	LkCa 4	3.37	3.37	3.36 (vr93)	3.3745	85-93⋆
376	TAP 26	2.51	2.52		2.50836	92-93
378	V819 Tau			5.6 (ry84)	5.5354	82-93⋆
379	LkCa 7, TAP 29	5.64		5.66 (gr92, vr93)	5.6638	85-93⋆
380	HDE 283572, TAP 31			1.55 (wa87)	1.529	92-93
388	TAP 35		2.74		2.73	92-93
	TAP 39		3.67		3.654	92-93
392	TAP 40		1.55		1.555	92-93
397	TAP 41		2.43		2.426	92-93
399	V827 Tau			3.75 (bo86)	3.75886	81-93⋆
403	TAP 45		6.2		9.91	92-93
405	V830 Tau			2.76 (ry84)	2.74079	82-93⋆
407	TAP 49		3.32		3.32	92-93
408	Wa Tau/1, TAP 50				3.06	93 +
420	LkCa 16	5.6			5.6	92-93
426	LkCa 19, TAP 56	2.24	2.24		2.236	90-93
427	TAP 57NW			9.32 (za93)	9.345	92-93
429	V836 Tau			6.99 (ry84)	6.755	82-93⋆

References to Table I:

bo86: Bouvier et al. (1986); bo93: Bouvier et al. (1993); gr91: Grankin et al. (1991); gr92: Grankin (1992); gr93: Grankin (1993); ry84: Rydgren et al. (1984); vr88: Vrba et al. (1988); vr93: Vrba et al. (1993); wa87: Walter et al. (1987); za93: Zakirov et al. (1993)

\# – according to Herbig and Bell (1988);

⋆ – it was used both our observations and others;

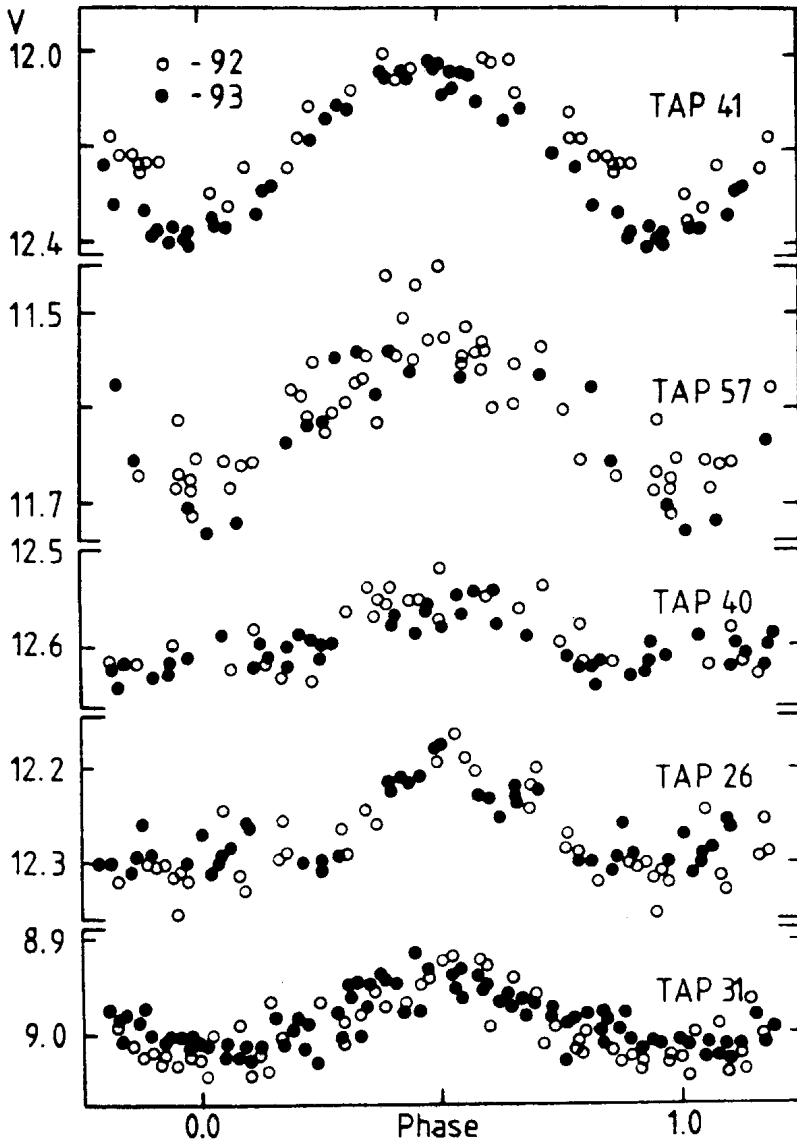\+ – this star was included in our observation program in 1993

Figure 1. Phase diagrams for light curves in the V filter for 5 WTTS.
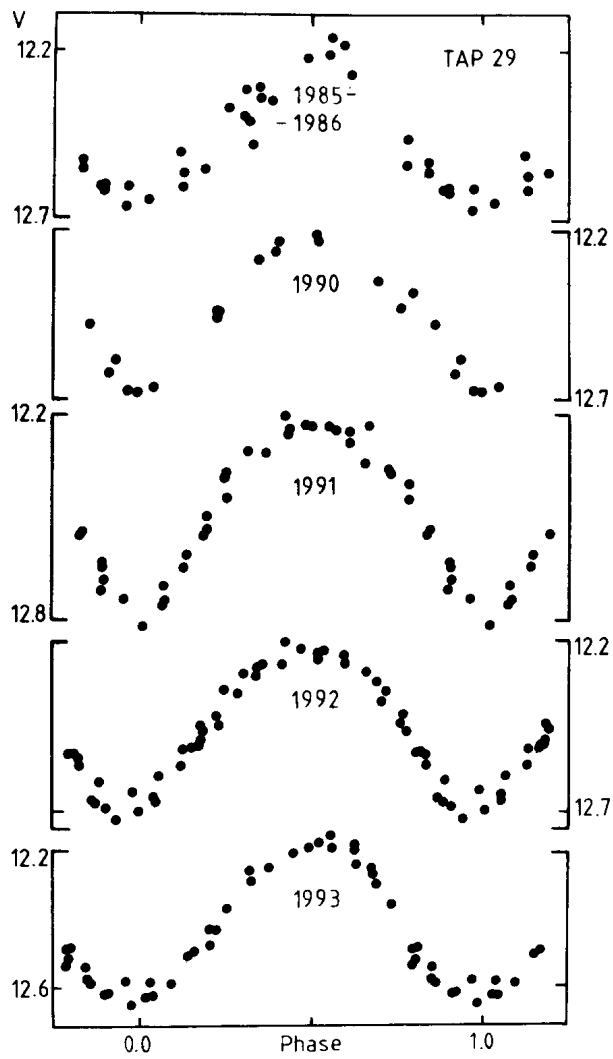Empty circles – data of 1992, filled circles – data of 1993.

Figure 2. Phase diagrams for different seasons of TAP 29 (LkCa 7).
For the 1985/86 season data from Vrba et al. (1993) are also shown.

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During observations from 1992 to 1993 we did not find any essential changes in the phase and frequency of the periodic processes for most of the WTTS with well-known periods (see Table 1 and Figure 1). Moreover, three stars (LkCa 4, LkCa 7, and VY Tau) keep their periods in 1985-1993 and four ones (V819 Tau, V827 Tau, V830 Tau, and V836 Tau) in 1982-1993. Only some small changes were found in the shape and the amplitude of their folded light curves (e.g. Figure 2).

It is known that the periodic variability of WTTS is mostly due to dark spots on their surfaces. The strict periodicities in the light curves of observed stars allow to suggest that the lifetimes and localization of the spot groups on the stellar surfaces do not change on the timescale from one to a few years. Hitherto only one WTTS (V410 Tau) with similar properties is known (Vrba et al., 1988).

The phenomenon of the spotted region stability on stellar surfaces seems to be explained either by strong local magnetic fields or the tidal interaction in the close binary systems (as RS CVn type).

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OUTBURST OBSERVATIONS OF LL ANDROMEDAE

LL Andromedae is an obscure object listed in the General Catalogue of Variable Stars as a possible U Gem star with a magnitude range of 13 to fainter than 17th. Wild (1979) reported the discovery of this object during which the star was seen to brighten to m_{pg} ∼13th and appeared to fade after about 10 days, although it was very poorly sampled. On 1993 Dec 07, LL And went into outburst and this note briefly describes our observations.

T. Vanmunster reported a rare outburst of LL And on 1993 Dec 7. This was quickly confirmed by G. Poyner and P. van Canteren and reported in Vanmunster and Poyner (1993). Figure 1 shows the outburst light curve of LL And as gathered from various observers. We see that the rise was very fast (<0.5 days) while the decline was slower, the outburst itself lasting about 8 days.

The minimum magnitude of LL And is estimated to be near V∼20±0.5 on the POSS O plate. The maximum V magnitude reached was 13.8 ±0.1, thus giving LL And an outburst amplitude of ∼6 magnitudes. A precise position for LL And is RA=$00^h39^m11^s90$ DEC=+26°20' 54".9 [1950].

Spectroscopic observations of LL And were made on UT 1993 Dec 8 and 9, both when LL And was near maximum at V∼14th magnitude. Our spectra show the Balmer Series and He 5876 as weak absorption lines, all with possible emission cores. Our spectra also show a rising blue continuum indicative of a DN in outburst.

Kato (1993) reported his discovery of superhumps in LL And from observations taken over a four-night period. He calculated a superhump period of 0.057006 days (1.37 hrs), one of the shortest known. In Table 1 we extend the tabulation of superhump periods given by Molnar and Kobulnicky (1992) with additional systems from the literature. We use all the stars with both orbital and superhump periods measured to derive a linear expression relating the two periods (periods given in days):

$$P_{SH}=1.06577(\pm0.01457)P_0-0.00160(\pm0.01564)$$

Note that this expression predicts that the superhump period and orbital period have a constant offset, regardless of orbital period. This simple approach provides observers with a fairly accurate starting point when looking for either period, if the other is known. It also fits all the known data to 1.5% as well. Figure 2 shows the results of this fit for the data in Table 1. Applying this equation to Kato's superhump period of LL And, we calculate an orbital period of 1.32 hours (79 minutes). This period is very close to the minimum orbital period allowed (∼72 min) by theory for solar composition stars (Nelson et al. 1985).
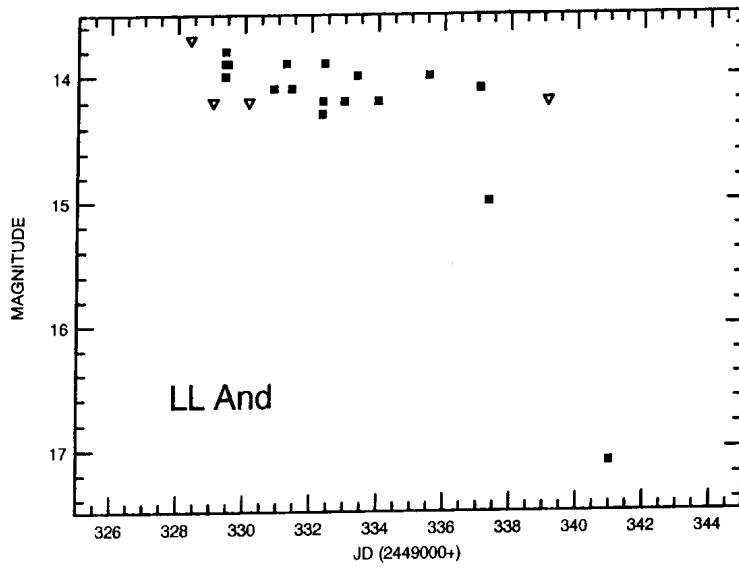
Figure 1. The outburst light curve of LL And. Open triangles are upper limits and filled squares have errors of ∼±0.1 mags.
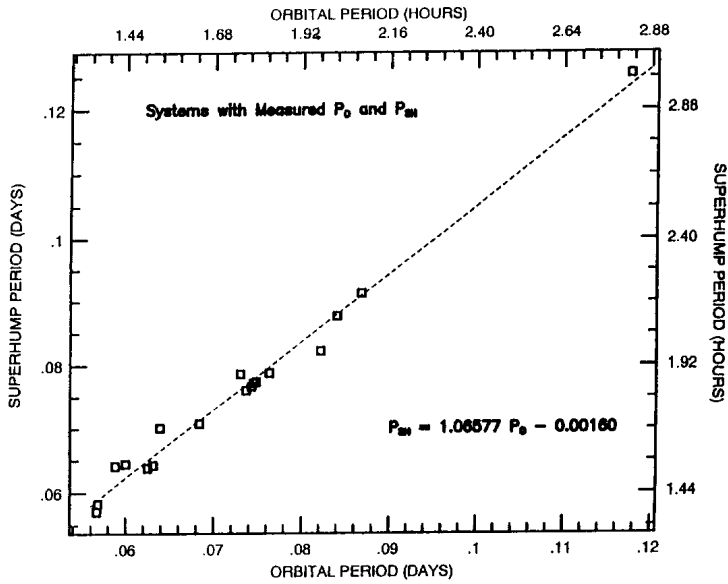

Figure 2. Linear relation between superhump period and orbital period.

Table 1

Short Period Dwarf Novae with Orbital and Superhump Periods[1]

Name	P_O (days)	P_{SH} (days)
WZ Sge	0.0567	0.0571
SW UMa	0.0568	0.0583
T Leo	0.0588	0.0641
HV Vir	0.0580	0.0584
VY Aqr	0.0600	0.0645
V436 Cen	0.0625	0.0638
OY Car	0.0631	0.0642
TY Psc	0.0639	0.0701
IR Gem	0.0684	0.0708
AW Gem	0.0730	0.0787
HT Cas	0.0736	0.0761
VW Hyi	0.0743	0.0767
Z Cha	0.0745	0.0773
WX Hyi	0.0748	0.0774
SU UMa	0.0764	0.0788
BR Lup	0.0822	0.0822
TY PsA	0.0840	0.0877
YZ Cnc	0.0868	0.0913
TU Men	0.1180	0.1255
WX Cet	(0.0513)	0.0530
LL And	(0.0550)	(0.0570)
CY UMa	(0.0571)	0.0593
AL Com	0.0583	(0.0606)
CI UMa	0.0604	(0.0628)
EK TrA	(0.0624)	0.0649
BC UMa	0.0632	(0.0657)
UV Per	(0.0637)	0.0663
AQ Eri	(0.0644)	0.0670
2138-453	0.0646	(0.0672)
SS UMi	(0.0672)	0.070
RZ Sge	(0.0673)	0.0702
EX Hya	0.0682	(0.0711)
FO And	(0.0700)	0.0730
RZ Leo	0.0708	(0.0739)
AY Lyr	(0.0728)	0.0760
V503 Cyg	0.0760	(0.0794)
CU Vel	(0.0765)	0.0799
TT Boo	0.0771	(0.0806)
EF Peg	(0.0832)	0.0871
KK Tel	0.0840	(0.0880)
DM Dra	0.0868	(0.0909)

[1] Numbers in () were calculated using the Eq. in text.

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The observation of LL And at outburst confirms it as a dwarf nova. The superhumps observed allow us to be fairly confident that LL And has a short orbital period. See Howell and Hurst (1994) for more details.

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VARIATIONS OF THE Ap STAR IN NGC 2169[1]

A period of 1^d56 had been determined by Maitzen & Lebzelter (1993) for the Δa and *uvby* variations of the Ap star Rns11180 (Renson 1991) = NGC2169-9 (Cuffey & Mc-Cuskey 1956) = NGC2169-12 (Hoag et al. 1961). This value has been recently questioned by Renson (1994), who favors a period of 0^d606 for the same data. However, these periods are based on only 7 Δa observations (Maitzen & Lebzelter 1993), and on two series of *uvby* data (Delgado et al. 1992) covering part of two nights.

Fortunately, four series of *uvby* CCD frames of the cluster had been secured during a four-night interval in January 94, at the 91cm Dutch telescope of the La Silla observatory.

The amplitude of the variations decreases from about 0^m15 in u down to about 0^m06 in y, making the ultraviolet and blue channels the most interesting for the period analysis. Figures 1 and 2 show the periodograms in, respectively, u and v.

Analysis of these data yields the following possible frequencies (periods):

$$f_1 = 0.321 \text{ d}^{-1} \quad (P_1 = 3^d111)$$
$$f_2 = 0.642 \text{ d}^{-1} \quad (P_2 = 1^d557)$$
$$f_3 = 0.797 \text{ d}^{-1} \quad (P_3 = 1^d254)$$
$$f_4 = 1.618 \text{ d}^{-1} \quad (P_4 = 0^d618)$$

Examination of the lightcurves indicates that the most probable is the second one, in agreement with Maitzen & Lebzelter's (1993) results.

It appears that $f_1 = f_2/2$ corresponds to a period twice the favored period (P_2); $f_3 \approx f_4/2$; and $f_4 \approx 1 + f_2$.

Hence f_4, which had been proposed by Renson (1994), simply is a 1-day alias of f_2.

By combining the 1994 data with those of Delgado et al. (1992), using the method described by Manfroid & Renson (1994), we end up with a large series of possible values:

$$f = 0.639795 \pm 0.000012 + n \times 0.0003364 \quad \text{d}^{-1}$$

with $n \leq 10$. This corresponds to $P = 1^d56300 \pm 0^d00001$ and aliases.

The v periodogram around frequency f_2 is shown in Fig. 3, while Figs. 4 and 5 show the v and u complete light curves folded with $P = 1^d56300$. As a comparison, the v light curve has been drawn in Fig. 6 for the best period found around 0^d606 (namely 0^d61861).

While our results do not unambiguously solve the problem of the period of NGC 2169-9, they point toward a value close to the one proposed by Maitzen & Lebzelter (1993) instead of the much shorter one favored by Renson (1994).

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[1] Based on observations carried out at the ESO La Silla Observatory
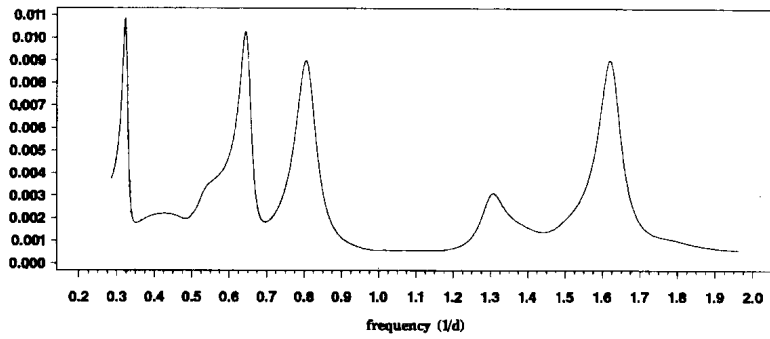
Figure 1: Periodogram in the u band for the 1994 data. The ordinate is the inverse of the chi-square calculated in a two-sine fit (see Manfroid & Renson 1994).
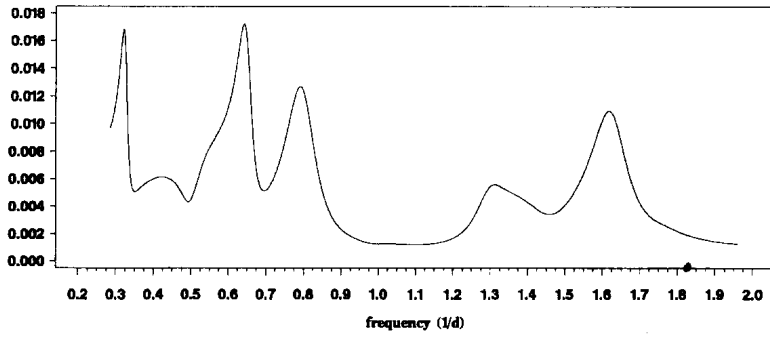
Figure 2: Periodogram in the v band for the 1994 data.

Figure 3: Periodogram around f_2 in the v band for the 1994 data and Delgado et al.'s (1992) data
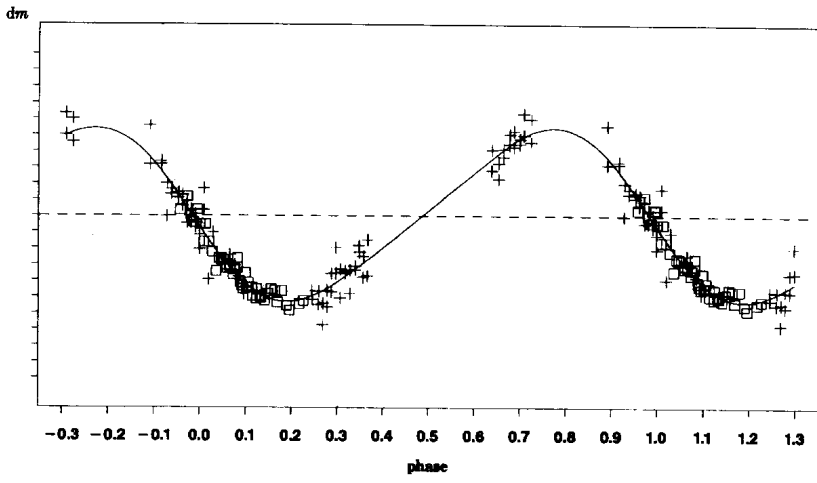
Figure 4: Lightcurve in the v band for the 1994 data (crosses) and Delgado et al.'s (1992) data (squares). $P = 1\overset{d}{.}56300$ and the phase origin is JD 2449279.0. Ticks on the ordinate axis are separated by $0\overset{m}{.}01$.
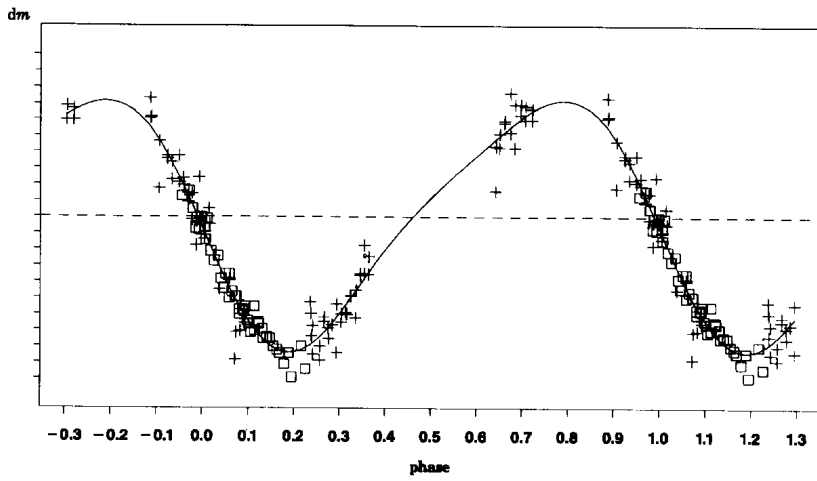
Figure 5: Same as Fig. 4 for the u band.

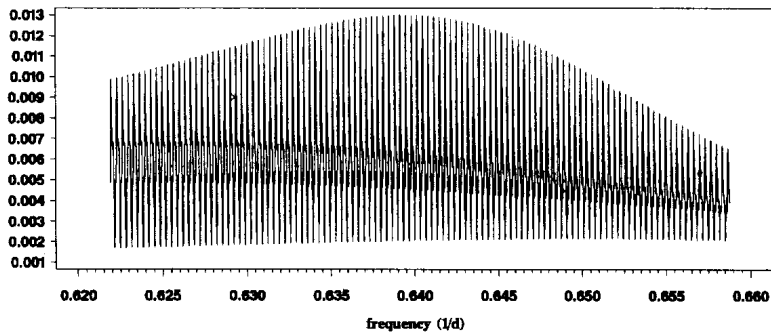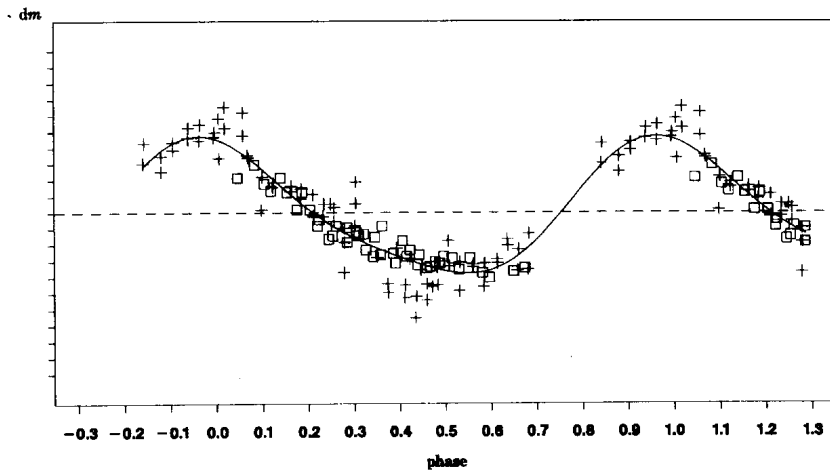Figure 6: Lightcurve in the v band for the 1994 data and Delgado et al.'s (1992) data. $P = 0\overset{d}{.}61861$ and the phase origin is JD 2449279.0

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NEW EPHEMERIS OF THE BINARY SYSTEM 44 i BOOTIS

Photometric observations of 44 i Bootis were made at Timisoara Observatory during July and August 1993.

Our photometric instrument consists of an EMI 9862Q photomultiplier attached to a 30 cm Cassegrain telescope. Observations were carried out using V filter (OG/2mm). As comparison star BD+48°2262 was used.

For the six observed minima we give in Table I the Julian dates and their mean errors, computed using Kwee–Van Woerden method.

Table I

No.	HEL.JD. 2440000.+	σ	Obs.	Filter
1	9178.4204	0.0015	Gherega	V
2	9186.4534	0.0005	”	V
3	9200.3765	0.0027	”	V
4	9207.3427	0.0019	”	V
5	9214.3066	0.0008	”	V
6	9215.3780	0.0009	”	V
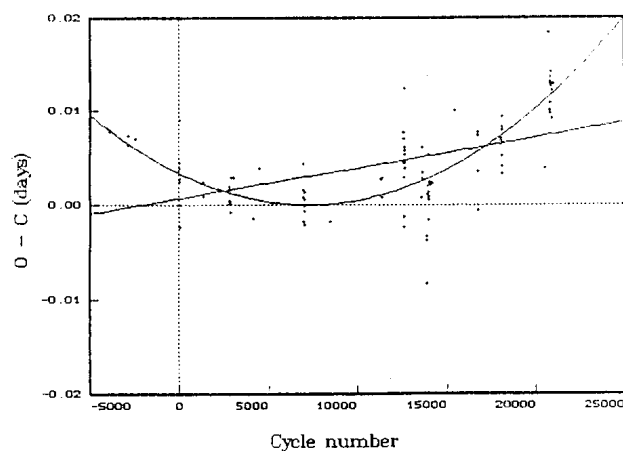
Figure 1

Table II

Hel.JD. 2440000+	O-C days	E cycle	Ref. no.	Hel.JD. 2440000+	O-C days	E cycle	Ref. no.
2531.4512	0.0080	-4007.0	[4]	6640.3005	0.0008	11335.0	[1]
2553.4119	0.0077	-3925.0	"	6638.2939	0.0028	11327.5	"
2837.5649	0.0063	-2864.0	"	6973.3286	-0.0022	12578.5	[11]
2841.5831	0.0072	-2849.0	"	6973.3296	-0.0012	12578.5	"
2953.5306	0.0070	-2431.0	"	6973.3352	0.0044	12578.5	"
3604.5880	0.0000	0.0	[5]	6977.3550	0.0069	12593.5	"
3607.5379	0.0039	11.0	"	6977.3510	0.0029	12593.5	"
3607.8107	0.0089	12.0	"	6977.3557	0.0076	12593.5	"
3614.3611	-0.0022	36.5	[14]	6984.3159	0.0046	12619.5	"
3614.5000	0.0028	37.0	"	6984.3174	0.0061	12619.5	"
3615.5710	0.0025	41.0	"	6984.3235	0.0122	12619.5	"
3616.3764	0.0044	44.0	"	6986.3253	0.0054	12627.0	"
3974.4464	0.0024	1381.0	[7]	6986.3238	0.0039	12627.0	"
3974.5788	0.0009	1381.5	"	6986.3257	0.0058	12627.0	"
4706.5219	-0.0013	4114.5	"	7242.4882	0.0008	13583.5	[15]
4709.4679	-0.0013	4125.5	"	7242.6248	0.0035	13584.0	"
4345.5067	0.0015	2766.5	[10]	7245.4395	0.0061	13594.5	"
4365.4569	-0.0007	2841.0	"	7245.5701	0.0028	13595.0	"
4366.5290	0.0002	2845.0	"	7338.3675	0.0014	13941.5	"
4349.3904	0.0019	2781.0	[2]	7338.5006	0.0006	13942.0	"
4351.5314	0.0004	2789.0	"	7340.3756	0.0009	13949.0	"
4354.4773	0.0002	2800.0	"	7341.3174	0.0053	13952.5	"
4355.5500	0.0017	2804.0	"	7341.4445	-0.0015	13953.0	"
4356.3523	0.0005	2807.0	"	7319.7446	-0.0082	13872.0	[19]
4366.7971	0.0004	2846.0	[17]	7319.7495	-0.0033	13872.0	"
4390.9032	0.0029	2936.0	"	7319.7491	-0.0037	13872.0	"
4409.7855	0.0041	3006.5	"	7322.7008	0.0020	13883.0	"
4811.7794	0.0039	4507.5	"	7322.6999	0.0011	13883.0	"
5473.8187	-0.0017	6979.5	"	7359.3920	0.0022	14020.0	[18]
5476.9019	0.0015	6991.0	"	7364.3469	0.0025	14038.5	"
5477.8383	0.0006	6994.5	"	7365.4180	0.0023	14042.5	"
5478.7745	-0.0006	6998.0	"	7371.4438	0.0022	14065.0	"
5488.8162	-0.0020	7035.5	"	7375.3270	0.0021	14079.5	"
5468.4684	0.0043	6959.5	[13]	7388.3163	0.0022	14128.0	"
5468.4649	0.0008	6959.5	"	7393.4050	0.0024	14147.0	"
5482.5245	-0.0000	7012.0	"	7739.2988	0.0099	15438.5	[12]
5482.5259	0.0014	7012.0	"	8086.3840	0.0035	16734.5	"
5870.4565	-0.0017	8460.5	"	8086.3881	0.0076	16734.5	"
6640.3026	0.0029	11335.0	[1]	8086.3877	0.0072	16734.5	"
6638.2938	0.0027	11327.5	"	8091.3346	-0.0005	16753.0	"

Table II (continued)

Hel.JD. 2440000+	O-C days	E cycles	Ref. no.	Hel.JD. 240000+	O-C days	E cycles	Ref. no.
8091.3346	-0.0005	16753.0	[12]	9162.3508	0.0134	20752.0	[16]
8429.8634	0.0070	18017.0	[3]	9162.3503	0.0129	20752.0	"
8429.8629	0.0065	18017.0	"	9168.3732	0.0099	20774.5	"
8429.8632	0.0068	18017.0	"	9168.3729	0.0096	20774.5	"
8437.7649	0.0078	18046.5	"	9168.3740	0.0107	20774.5	"
8437.7663	0.0092	18046.5	"	9177.3478	0.0126	20808.0	"
8437.7623	0.0052	18046.5	"	9177.3482	0.0130	20808.0	"
8439.7698	0.0041	18054.0	"	9177.3479	0.0127	20808.0	"
8439.7739	0.0082	18054.0	"	9178.4204	0.0140	20812.0	This
8439.7690	0.0033	18054.0	"	9186.4534	0.0124	20842.0	paper
9099.4042	0.0039	20517.0	[16]	9200.3765	0.0090	20894.0	"
9149.3581	0.0099	20703.5	"	9207.3427	0.0120	20920.0	"
9149.3664	0.0182	20703.5	"	9214.3066	0.0126	20946.0	"
9159.4094	0.0180	20741.0	"	9215.3780	0.0127	20950.0	"

The O−C residuals were computed using the ephemeris:

$$\text{Min I} = \text{J.D. } 2443604.5880 + 0^{d}26781753 \times E \tag{1}$$

given by Oprescu et al. (1989). In Table II we give the O−C residuals, computed for the Julian dates of minima, given in references, completed with O−C values from our observations. In Figure 1 we plotted the O−C residuals versus the number of periods denoted by E.

Considering a linear ephemeris, the least squares method yields:

$$\text{Min I} = 2443604^{d}5887 + 0^{d}26781785 \times E \tag{2}$$
$$\pm 0^{d}0006 \; \pm 0^{d}00000004$$

Or, considering quadratic ephemeris, the same method leads to:

$$\text{Min I} = 2443604^{d}5914 + 0^{d}26781662 \times E + 0^{d}62 \times 10^{-10} \times E^{2} \tag{3}$$
$$\pm 0^{d}0004 \pm 0^{d}00000009 \quad \pm 0^{d}05 \times 10^{-10}$$

The comparison of the two fits (ephemerides (2) and (3)) is seen in Figure 1. We found that quadratic ephemeris fits better the observations.

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NEW FLARE STARS IN THE CYGNUS T1 ASSOCIATION REGION

Seven flare stars were found during the examination of the photographic material of the Cygnus association region. Observations were carried out on the 26" Schmidt telescope of Tonantzintla Observatory (INAOE) during 1974-1982. Total observational time was about 88^h.

In Table 1 data on new flare stars are given. In the first column we continue the Tonantzintla numbering of the Cygnus flare stars (Haro & Chavira, 1973). Columns second to sixth give the approximate coordinates (error in R.A. $\pm$ 5^s in Dec. $\pm$ 9"), ultraviolet magnitude at minimum, flare amplitude, date of flare respectively.
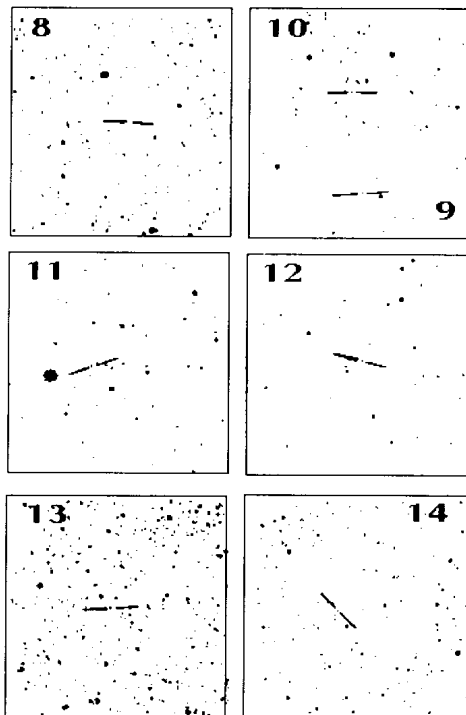

Figure 1. Identification charts for the new flare stars. North is at the top, East is to the right. The size of the chart is 12×12 arcmin.

Table 1

New flare stars in the Cygnus T1 association region

No. Ton	R.A. 1950	Dec. 1950	U mag	ΔU mag	Date of flare
8	20^h46^m8	$45°36'0$	>18	>3.5	12.10.1974
9	20 53.1	42 47.4	~18	~3.5	09.07.1978
10	20 53.2	42 53.1	16.4	0.8	25.07.1976
11	20 53.4	43 11.0	17.6	2.8	20.08.1974
12	20 56.0	43 39.2	≥18	≥4.0	07.09.1977
13	20 59.1	42 46.8	17.4	3.7	01.09.1978
14	21 05.3	42 13.5	15.9	1.7	24.08.1974

In Figure 1 the identification maps of newly found flare stars are given. We thank C. Escamilla for technical help.

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Haro, G., and Chavira, E., 1973, *Bol. Inst. Tonantzintla*, 1

NEW FLARE STARS IN THE REGION OF
OPHIUCHUS AND SCORPIUS

The first four flare stars in the recent star formation region of ρ Ophiuchi were found by Haro & Chavira (1974), based on effective observational time equal to 43 hours. The same region was observed on Tonantzintla 26" Schmidt telescope during 1975-1983. Four new flare stars were found again. Total observational time was equal to 149^h.

In Table 1 data on the new flare stars are given. Columns first to sixth give the serial number of flare star, approximate coordinates (error in R.A. $\pm 5^s$, in Dec. $\pm 9"$), ultraviolet magnitude at minimum, flare amplitude and date of flare respectively.
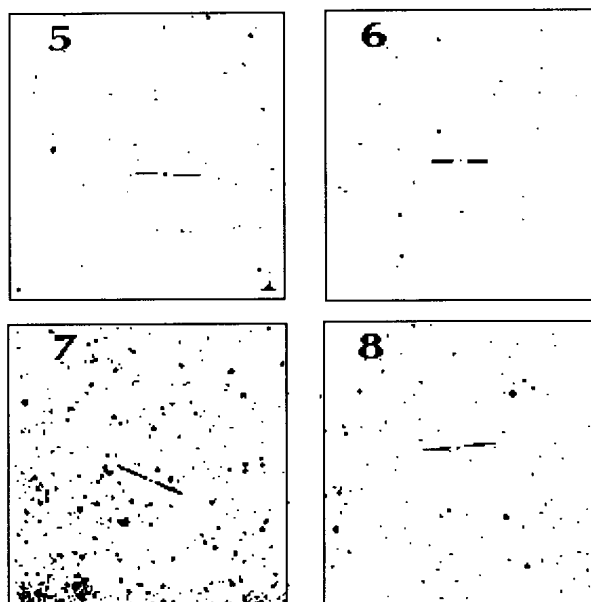

Figure 1. Identification charts for the new flare stars. North is at
the top, East is to the right. The size of the charts is 12×12 arc min.

Table 1. New flare stars in Ophiuchus and Scorpius

No. Ton.	R.A. 1950	Dec. 1950	U mag	ΔU mag	Date of flare
5	16^h22^m8	$-23°12'$	>18	>2.9	09.06.1980
6	16 23.3	$-23\ 37$	>18	>2.3	05.07.1978
7	16 25.7	$-25\ 48$	>18	>2.4	06.04.1976
8	16 33.1	$-26\ 12$	>18	>6	15.05.1975

Flare of star No.8 was probably a superposition of two fast flares occurring within a time interval of about 30 minutes. The first flare began a little earlier than 5^h22^m with amplitude $\geq3^m$, then at 5^h54^m or a little earlier the second fast flare took place, with an amplitude of $\geq6^m$. Another possibility is to suppose that it was a slow flare, but the shape of light curve is in favour of the first assumption. The data on flare of the star No. 8 are given in Table 2.

Table 2

UT	m_u	UT	m_u
5^h22^m	15^m0	6^h41^m	14^m5
5 38	15.5	7 00	14.8
5 54	12.0	7 16	15.6
6 10	12.5	7 32	16.0
6 25	13.5	7 48	16.5

This star has $H\alpha$ in emission (Wilking et al., 1987).

Thus, during 192 hours of observations, only 8 flare stars were found in the region of Ophiuchus and Scorpius. In Figure 1 the identification maps of the newly found flare stars are given.

We thank C. Escamilla for technical help.

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OPTICAL SPECTROSCOPY OF A FLARE ON PROXIMA CENTAURI

On 9 March 1994, a large flare event on Proxima Centauri (Gliese 551 = LHS 49 = V645 Cen) was serendipitously observed with the CTIO 1.0-m telescope Cassegrain Image Tube Spectrograph, the "2D-Frutti". Presented here is a spectrum taken during the flare event and, for comparison, spectra taken during quiescence on the two following nights.

Proxima Cen was observed as part of a spectral-typing program being carried out during non-photometric nights on the CTIO 1.0-m telescope. The 2D-Frutti spectrometer was configured with grating #26 (600 lines/mm, 5000Å blaze) in first order to provide coverage in the spectral range of 4200–7600Å with a resolution of 3–4Å around Hα (6563Å). Because the observing conditions were non-photometric, these spectra are not flux calibrated. Instead, an instrumental spectral response function was derived by comparing observations of A-type field stars to the flux distribution of A-type spectrophotometric standard stars.

Table 1 contains details of the individual observations and lists equivalent widths (EW), measured with respect to the local continuum, for the hydrogen Balmer lines during the flare and on subsequent nights during quiescent periods. Figure 1 shows the spectrum of Proxima Cen while in flare and, for comparison, one of the quiescent period spectra.

Table 1
Spectroscopic Observations of Proxima Centauri

UT Date (at midpoint)	Exposure Time (sec)	Hα	EW(Å) Hβ	Hγ	Notes
1994 March 09 7:33	480	27	92	173	1
1994 March 10 7:27	600	4	6	20	
1994 March 10 8:59	600	3	6	19	
1994 March 10 9:09	600	3	3	14	
1994 March 11 6:27	600	3	<2	10	2

Notes.– Equivalent widths are reported to the nearest Ångstrom; (1) Also seen in emission are He I(4471Å) EW = 10Å, He I(5876Å) EW = 7Å, Na I D lines (5890Å and 5896Å), and He I(6678Å) present but weak; (2) Hβ present in emission but weak.

Despite being the most nearby example of a dMe flare star, only a few optical spectra of Proxima Cen are found in the literature (e.g. Thackeray 1950; Mathioudakis & Doyle 1991). The flare spectrum in Figure 1 shows strong enhancement of Balmer line emission along with emission lines of He I (4471Å, 5876Å, and 6678Å) and the Na I D lines (5890Å
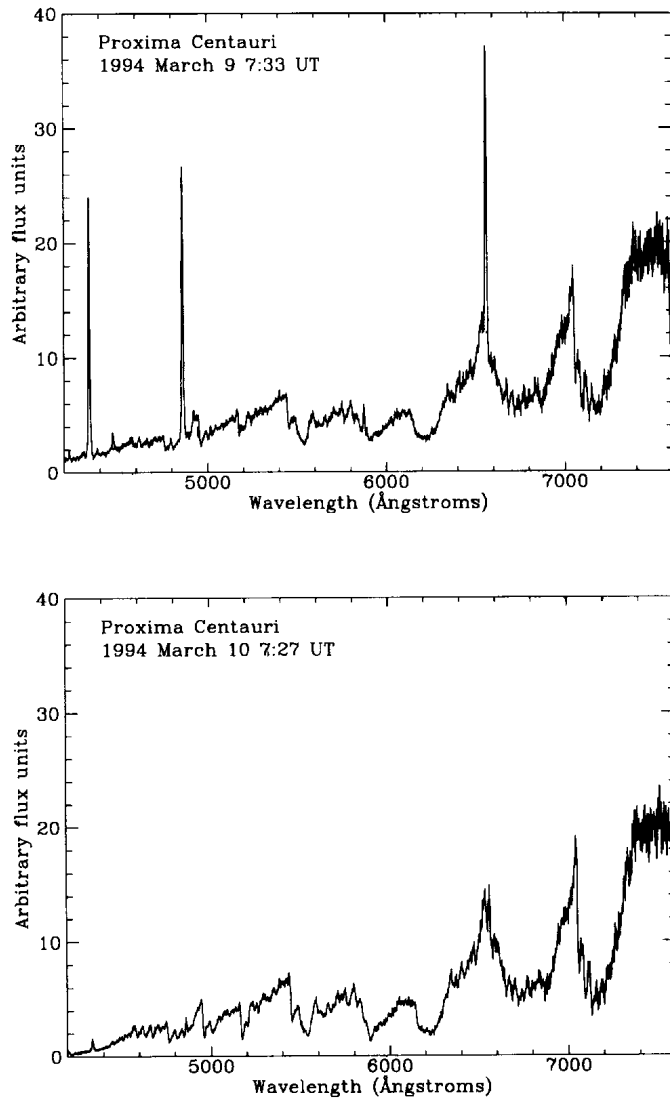
Figure 1: *Top*, Proxima Centauri in flare on 9 March 1994. The hydrogen Balmer lines are the most prominent emission lines in this spectrum. *Bottom*, Proxima Centauri during a quiescent period on 10 March 1994. These spectra *are not* flux calibrated.

and 5896Å). The Hα equivalent width in flare is enhanced by factor of about 10 over that in the observed quiescent period observations and by a factor of 15 over the quiescent Hα equivalent width reported by Mathioudakis & Doyle (1991). The Hβ and Hγ lines show much larger enhancement factors during the flare. The continuum during the flare appears to be enhanced blueward of 4500Å.

Although Proxima has a lower rate of flare *production* than other flare stars (Walker 1981), it apparently does experience large flares from time to time. For comparison, a $\Delta U = 5.0$ magnitude flare event on UV Ceti, a classic prototypical flare star, produced EW(Hα) = 67.5Å and EW(He I (5875Å)) = 15.5Å (Eason *et al.* 1992). Because no earlier observations were made of Proxima Cen on 9 March, the serendipitous flare spectrum presented here may not represent flare maximum for this particular event.

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OPTICAL SPECTROSCOPY AND PHOTOMETRY OF EX LUPI

EX Lupi (HD 325367 = HBC 253 = HV 11976) is an irregular variable star that falls into the class of pre-main sequence stars called EXors (Herbig 1989) or "eruptive" T Tauri stars. Eruptive T Tauri stars display outburst phenomena similar to that seen in the FU Orionis variables, but differ from that class in that the time spent at maximum light during an outburst is a only few hundred days and the change in brightness is only a few magnitudes in V. Historically, EX Lupi had at least five outbursts during the period 1893 to 1941 (McLaughlin 1946). A major event in 1955–1956 saw the star brighten to $V_{max} = 8.4$ from $V = 13.2$, the largest outburst ever recorded for this star (Bateson and Jones 1957, as cited by Herbig *et al.* 1992). Recently, EX Lupi went into outburst in early 1993, with $V_{max} = 11.4$ (Jones and Albrecht 1993). In early 1994, EX Lupi again brightened, reaching $V_{max} = 11.24$ (this paper). Presented here are optical photometry and spectroscopy taken during this latest outburst.

EX Lupi was observed with the Cassegrain Image Tube Spectrograph (the "2D-Frutti") and the Automated Single-Channel Aperture Photometer (PC-ASCAP) on the CTIO 1.0-m telescope during the period 1994 March 4 - 24.

The 2D-Frutti spectrograph was configured with grating #26 (600 lines/mm, 5000Å blaze) in first order to provide coverage in the range of 4200–7600Å with a spectral resolution of 3–4Å around Hα (6563Å). Because the spectrograph was generally used on non-photometric nights, these spectra are not flux calibrated. Instead, an instrumental spectral response function was derived by comparing observations of A-type stars to the flux distribution of A-type spectrophotometric standard stars. Details of the individual spectroscopic observations and measured equivalent widths for the hydrogen Balmer lines are presented in Table 1. Figure 1 shows two spectra, one taken close to V_{max} for this latest outburst and, for comparison, one taken 19 nights later when the star had faded by about 1 magnitude in V.

Table 1
Spectroscopic Observations of EX Lupi

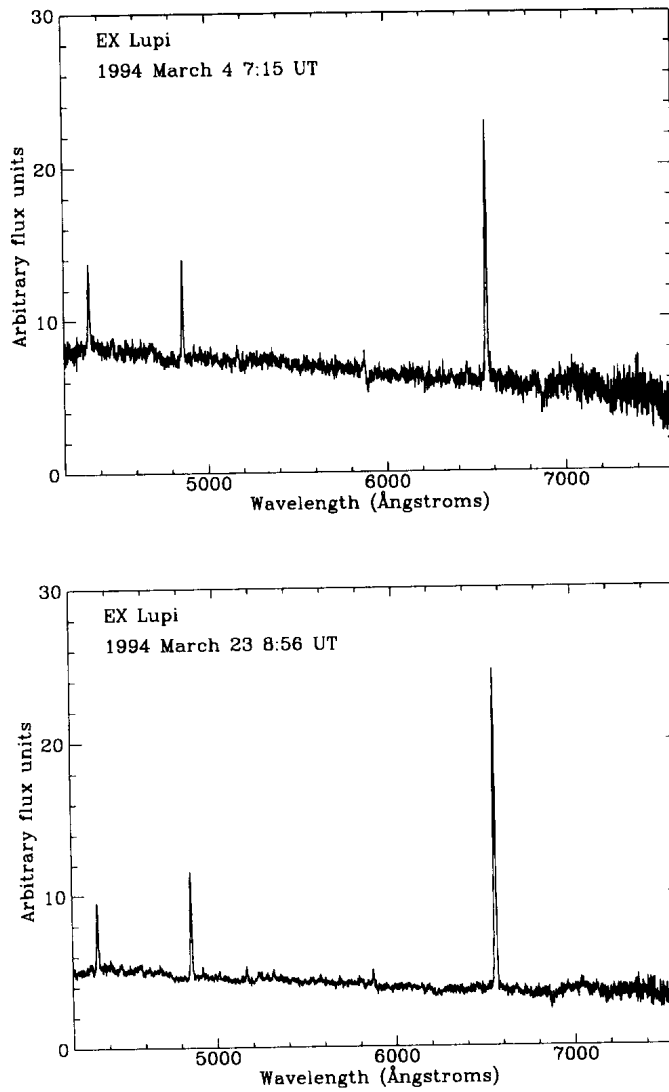| Julian Date (+2440000)	Exposure Time (sec)	Hα	EW(Å) Hβ	Hγ
9415.80	300	35	10	8
9418.87	480	45	12	7
9421.83	600	35	14	9
9422.82	600	32	11	10
9434.88	900	65	16	9

Figure 1: *Top*, EX Lupi on 4 March 1994 near maximum brightness in its latest outburst. The most prominent emission lines in this spectrum are the Balmer lines of hydrogen. *Bottom*, EX Lupi on 23 March 1994 after fading almost 1.0 magnitude in V from maximum brightness. These spectra *are not* flux calibrated.

Table 2
Photoelectric Observations of EX Lupi

Julian Date (+2440000)	$B - V$	$V - R_c$	$R - I_c$	V
9414.841	...	0.43	0.55	11.24
9424.831	...	0.48	0.63	11.84
9425.844	...	0.53	0.69	12.00
9426.844	...	0.57	0.73	12.11
9427.838	...	0.57	0.70	12.01
9428.847	0.60	0.62	0.72	12.12
9429.832	...	0.61	0.71	12.16
9429.868	...	0.64	0.72	12.22
9429.871	...	0.62	0.74	12.21
9429.879	...	0.61	0.74	12.21
9430.837	...	0.57	0.67	12.03
9430.880	...	0.58	0.68	12.04
9431.827	0.48	0.50	0.63	12.00
9431.864	0.48	0.49	0.64	12.00
9431.877	0.49	0.49	0.63	12.02
9432.828	...	0.52	0.59	11.81
9432.869	...	0.53	0.63	11.89
9432.882	...	0.53	0.62	11.91
9433.775	0.51	0.53	0.66	12.01
9433.815	0.46	0.54	0.65	11.98
9433.818	0.46	0.54	0.64	11.99
9433.820	0.45	0.54	0.64	11.98
9433.823	0.47	0.53	0.65	11.97
9433.862	0.47	0.53	0.64	11.96
9433.865	0.48	0.51	0.64	11.95
9433.870	0.43	0.54	0.63	11.96
9433.873	0.45	0.55	0.64	11.97
9433.876	0.45	0.53	0.64	11.96
9433.879	0.44	0.54	0.64	11.96
9433.881	0.46	0.52	0.65	11.95
9435.867	0.63	0.62	0.76	12.20
9435.874	0.60	0.64	0.77	12.22
9435.884	0.64	0.63	0.76	12.21

4

The PC-ASCAP system was configured with a $BVRI$ filter set and a 19 arcsecond aperture. The data were reduced using standard methods and were placed on the BVR_cI_c system using observations of photometric standard stars (Graham 1982). The resulting magnitudes and colors are presented in Table 2. Photometric errors are about 1%, except for the $B - V$ color, which has about 2% errors.

The spectra are dominated by Balmer emission lines and an early-type continuum devoid of absorption features. There are a few other emission lines in the spectra, such as those of He I(4471Å and 5876Å) and Fe II(4924Å), but they are generally weak, with equivalent widths < 3Å. The equivalent widths measured by Appenzeller et. al (1983), when EX Lupi was at $V = 13.7$, are comparable to those measured for this outburst. During the 1993 outburst Herbig (1994) measured EW(Hβ) = 24.0 and 20.2Å and EW(Hγ) = 18.0 and 18.1Å for $V \approx 12.4$ on April 27 of that year. Although all these observations together span ~2.5 magnitudes in V, the Balmer line equivalent widths do not appear to change much between the outburst and quiescent phases.

The peak brightness of our V photometry ($V_{max} = 11.24$) is a little brighter than that recorded for the 1993 May outburst, however since this monitoring campaign began with EX Lupi apparently on the decline, the true maximum may have been brighter still. Over the 21 nights of observation in which photometry was recorded, the star was highly variable with a magnitude range of 11.24–12.22 in V. Repeated observations on March 21 and March 22 (JD 2449432 and 2449433) show that the star is active on time scales of minutes, with a few percent change in magnitude and colors.

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V800 Aql IS A CLASSICAL CEPHEID

This star was investigated by several authors. Hoffmeister (1949) determined the variable's type as U Gem (Z Cam) and variability range 14^m-16^mpg. Götz (1955, 1956) found limits 12^m8-15^m7 and type RW Aur.

The star was estimated by us on 109 photographic plates, taken from JD 2440763 to 47749. The finding chart and magnitudes of comparison stars are presented in Figure 1.

Periodic variability of V800 Aql with a light curve typical for classical Cepheis was found. Light elements for it are JD Max=$2445221.26+20^d065 \times$E and variability range is 14^m4-16^m5 in B band. The light curve is given in Figure 2. The uncertainty of the value of the period is $\pm 0^d004$.

The star is yellow on the Palomar atlas charts in agreement with the δ Cep type. The galactic coordinates according to GCVS IV are l=$43°14$, b=$3°79$.

It is desirable to continue observations of this star.

Star	B
a	13^m58
b	14.85
c	15.48
d	15.85
e	16.40

Figure 1. The finding chart of V800 Aql
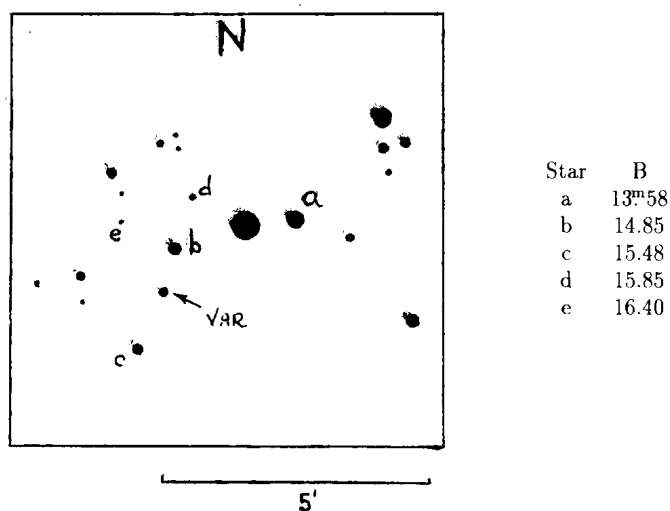
2
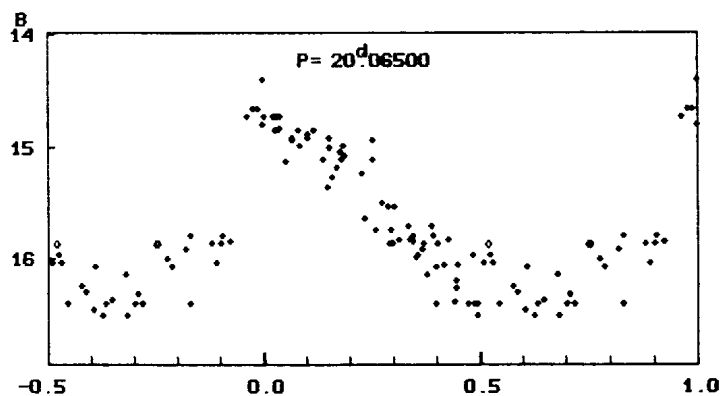
Figure 2. The mean light curve of V800 Aql.
Uncertain observations are shown as open circles.

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1992, 1993 BV PHOTOELECTRIC OBSERVATIONS OF CG Cyg

Photometric observations for this star have been reported previously by Zeilik et al. (1991), Dapergolas et al. (1992), Dapergolas et al. (1989a) and references therein.

The eclipsing binary CG Cyg was observed for the periods 19-27 July 1992, 29-30 September 1992, 15-22 July 1993 and 23-25 August 1993 with the 1.2m Kryonerion telescope and a single-channel photon counting photometer described by Dapergolas and Korakitis (1987). The photometer employs a high gain 9789QB phototube and conventional BV filters. Its output is fed directly to a microcomputer enabling rapid data access.

The data reduction method is the standard one and as a comparison star BD +34°4216 was used. The constancy of the comparison star was verified by Milone et al. (1979). The data presented here were obtained with an accuracy of ±0.015 mag.

Table 1 lists the dates of observations and phases covered whereas Figure 1, 2, 3 and 4 summarize the results for July 1992, September 1992, July 1993 and August 1993 respectively.

From the times of minima found here and those published by Milone et al. (1979) and Dapergolas et al. (1989a, 1989b, 1991, 1992) the O−C residuals show large variations which might be due to the continuous period variations of the system.

In Table 2 the times of minima and the O−C values are listed for the V and B bands respectively. Times of minima are calculated using the method described by Kwee and van Woerden (1956 whereas the O−C values were determined from the linear ephemeris $T=2439425\overset{d}{.}1221+0\overset{d}{.}631141\times E$ given by Milone and Ziebarth (1974).

Table 1

Date	Phase		Date	Phase	
19 July 1992	.80	.00	15 July 1993	.77	.20
20 July 1992	.37	.43	16 July 1993	.36	.79
	.54	.80	17 July 1993	.96	.37
21 July 1992	.95	.39	18 July 1993	.52	.94
24 July 1992	.73	.08	19 July 1993	.11	.54
25 July 1992	.31	.53	20 July 1993	.73	.13
27 July 1992	.47	.66	21 July 1993	.29	.70
29 Sep. 1992	.79	.16	22 July 1993	.93	.14
30 Sep. 1992	.35	.75	23 Aug. 1993	.57	.99
			24 Aug. 1993	.12	.58
			25 Aug. 1993	.75	.19

2

Table 2

| Date	Type of minima	V colour Heliocentric Julian Day	O−C phase	B colour Heliocentric Julian Day	O−C Phase
21/7/1992	Primary	2448825.3666 ±0.0002	0.048	24448825.3669 ±0.0001	0.049
24/7/1992	Primary	2448828.5222 ±0.002	0.048	2448828.5223 ±0.0003	0.048
27/7/1992	Secondary	2448831.3629 ±0.0003	0.549	2448831.3632 ±0.0005	0.549
29/9/1992	Primary	2448895.4236 ±0.0001	0.049	2448895.4236 ±0.0001	0.049
30/9/1992	Secondary	2448896.3711 ±0.0002	0.550	2448896.3709 ±0.0003	0.550
15/7/1993	Primary	2449184.4875 ±0.0001	0.051	2449184.4873 ±0.0001	0.051
16/7/1993	Secondary	244185.4321 ±0.0001	0.548	2449185.4324 ±0.0002	0.548
17/7/1993	Primary	2449186.3808 ±0.0002	0.051	2449186.3808 ±0.0001	0.051
20/7/1993	Primary	2449189.5366 ±0.0001	0.051	2449189.5366 ±0.0001	0.051
22/7/1993	Primary	2449191.4298 ±0.0001	0.051	2449191.4299 ±0.0001	0.051
24/8/1993	Secondary	2449224.5631 ±0.0004	0.548	2449224.5631 ±0.0003	0.548
25/8/1993	Primary	2449225.5114 ±0.0001	0.051	2449225.5115 ±0.0001	0.051
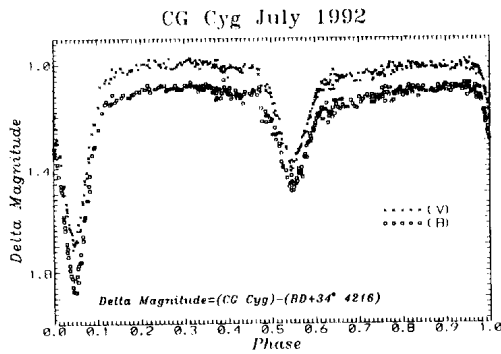
Figure 1.

From Figures 1, 2, 3 and 4 it can be seen that there are irregularities outside the eclipse already reported previously by Milone et al. (1979), Dapergolas et al. (1989b), Beckert et al. (1989), Dapergolas et al. (1991), Zeilik et al. (1991), Dapergolas et al. (1992) and Zeilik et al. (1994). From the Figures 1 and 2 it can be seen that there is a significant difference in the light curves outside the eclipses for the phases 0.6-0.95 whereas there is no difference for the phases 0.1-0.45 whereas from Figures 3 and 4 of the year 1993 it can be seen that there is no significant difference in the light curves.

The observed differences between the primary and secondary minima for the period 1987-1993 are shown in Table III (Dapergolas et al., 1988, 1989a, 1989b, 1991, 1992).
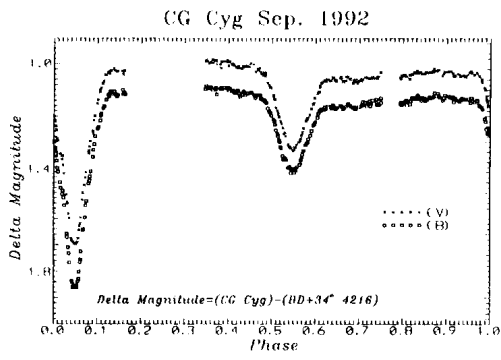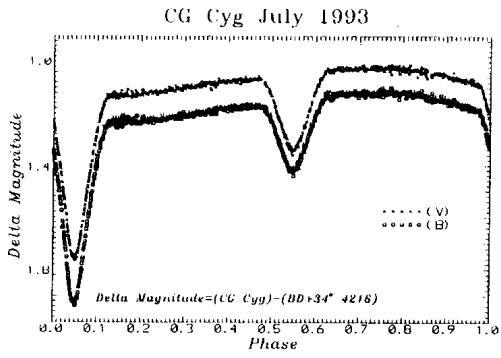
CG Cyg Sep. 1992
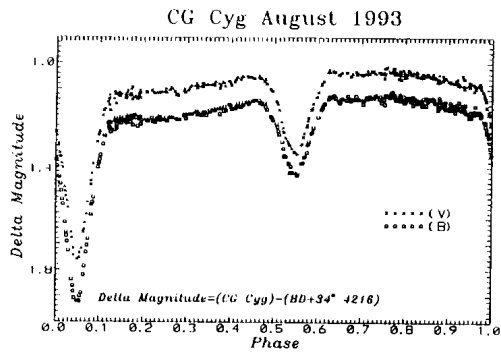

Figure 2

CG Cyg July 1993

Figure 3

CG Cyg August 1993

Figure 4

4

Table 3
Differences between primary and secondary
minima for CG Cygni in B and V colours

Date	δB (mag)	δV (mag)
1987 July	0.41	0.30
1988 Sept.	0.34	0.30
1989 July	0.45	0.39
1990 July	0.48	0.37
1991 July	0.46	0.37
1992 July	0.38	0.30
1992 Sept.	0.43	0.36
1993 July	0.50	0.40
1993 Aug.	0.49	0.42

From the values of Table 3 it can be seen that there is a variation in the difference of both minima depths and for both colours probably due to the photospheric activity of the system.

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THE PERIOD OF AG PHOENICIS HAS DECREASED

This study is based upon the photographic times of minimum from the epoch of discovery of the light variation of this system (Strohmeier, 1972) and on the photoelectric times of minimum derived by the author in two observational seasons at CTIO [1] in Chile, during 1979 and 1984 in the UBV and VRI systems, respectively (Cerruti, 1980; 1993). The 'history' of the system comprises about 10000 cycles.

The bisection-of-chords method was used for the determination of the UBV times of minima while Kwee and Van Woerden's (1956) algorithm was used with the VRI observations. Standard deviations were assigned to the photographic minima based in the displayed values of the residuals by an unweighted linear least squares fit of these minima. The dispersion used for the photoelectric minima was that of the output of the applied method.

In Table 1 are displayed the residuals (O-C) and (O-C)' from two linear least squares solutions between the three epochs of observation. The derived ephemerides are:

$$\text{Min I} = \text{HJD } 2444170\overset{d}{.}79581 + 0\overset{d}{.}75534298 \times \text{E} \tag{1}$$
$$\pm 0\overset{d}{.}0048 \pm 0\overset{d}{.}00000051 \text{ m.e.}$$

$$\text{Min I} = \text{HJD } 2444170\overset{d}{.}79505 + 0\overset{d}{.}75533906 \times \text{E} \tag{2}$$
$$\pm 0\overset{d}{.}00013 \pm 0\overset{d}{.}00000011 \text{ m.e.}$$

Figure 1 depicts the behaviour of the residuals for the two solutions. The period decreased by $\Delta P/P = -5.2 \times 10^{-6}$ in 21 years leading to $\dot{P}/P = -2.47 \times 10^{-7}$ per year and an associated time scale of period changes of 4.0×10^{6} years.
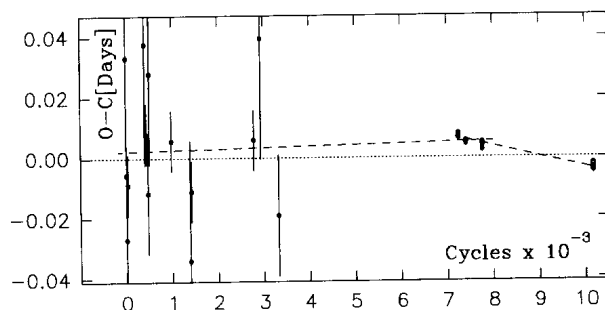

Figure 1. Behaviour of the O–C residuals for AG Phe form the ephemeris T=HJD 38309.332+0.7553426×E. Filled circles stand for primary minima.

Table 1. Times of minima and residuals for AG Phe

Ref.	Min.	Band	HJD (sigma) 2400000+	E	(O-C)	(O-C)'
1	I	pg.	38309.3650(0.0300)	-7760.0	0.0307	
1	I	pg.	38315.3690(0.0100)	-7752.0	-0.0080	
1	I	pg.	38318.3690(0.0300)	-7748.0	-0.0294	
1	I	pg.	38340.2920(0.0100)	-7719.0	-0.0113	
1	I	pg.	38614.5280(0.0400)	-7356.0	0.0352	
1	I	pg.	38642.4460(0.0100)	-7319.0	0.0055	
1	I	pg.	38670.3740(0.0200)	-7282.0	-0.0142	
1	I	pg.	38695.3400(0.0300)	-7249.0	0.0255	
1	I	pg.	39053.3500(0.0100)	-6775.0	0.0029	
1	I	pg.	39361.4900(0.0400)	-6367.0	-0.0370	
1	I	pg.	39383.4180(0.0100)	-6338.0	-0.0140	
1	I	pg.	40415.2330(0.0100)	-4972.0	0.0025	
1	I	pg.	40526.3020(0.0400)	-4825.0	0.0361	
1	I	pg.	40823.0930(0.0200)	-4432.0	-0.0227	
2	I	U	43778.7756(0.0003)	-519.0	0.0028	0.0015
2	I	B	43778.7745(0.0003)	-519.0	0.0017	0.0004
2	I	V	43778.7749(0.0004)	-519.0	0.0021	0.0008
2	I	U	43781.7956(0.0009)	-515.0	0.0014	0.0002
2	I	B	43781.7954(0.0004)	-515.0	0.0012	0.0000
2	I	V	43781.7957(0.0003)	-515.0	0.0015	0.0003
2	I	U	43902.6483(0.0010)	-355.0	-0.0008	-0.0014
2	I	B	43902.6487(0.0003)	-355.0	-0.0004	-0.0010
2	I	V	43902.6494(0.0003)	-355.0	0.0003	-0.0003
2	I	U	44170.7948(0.0003)	0.0	-0.0010	-0.0003
2	I	B	44170.7949(0.0004)	0.0	-0.0009	-0.0002
2	I	V	44170.7951(0.0008)	0.0	-0.0007	0.0000
2	I	U	44171.5501(0.0003)	1.0	-0.0011	-0.0003
2	I	B	44171.5507(0.0007)	1.0	-0.0005	0.0003
2	I	V	44171.5509(0.0003)	1.0	-0.0003	0.0005
2	I	U	44173.8144(0.0009)	4.0	-0.0028	-0.0020
2	I	B	44173.8157(0.0004)	4.0	-0.0015	-0.0007
2	I	V	44173.8161(0.0004)	4.0	-0.0011	-0.0003
2	I	U	44174.5721(0.0008)	5.0	-0.0004	0.0004
2	I	B	44174.5717(0.0003)	5.0	-0.0008	0.0000
2	I	V	44174.5715(0.0004)	5.0	-0.0010	-0.0002
3	I	V	45986.6300(0.0004)	2404.0		-0.0002
3	I	R	45986.6299(0.0006)	2404.0		-0.0003
3	I	I	45986.6297(0.0006)	2404.0		-0.0005
3	I	V	45988.8961(0.0006)	2407.0		-0.0001
3	I	R	45988.8963(0.0003)	2407.0		0.0001
3	I	I	45988.8963(0.0004)	2407.0		0.0001
3	II	V	45990.7840(0.0011)	2409.5		-0.0005
3	II	R	45990.7855(0.0011)	2409.5		0.0010
3	II	I	45990.7861(0.0009)	2409.5		0.0016

1) Strohmeier (1972);
2) 1979 minima;
3) 1984 minima.

3

Because the system is believed to be in an almost semidetached configuration (Cerruti, in preparation) with the less massive component near filling its Roche lobe, the interpretation of this decrease in terms of pure conservative mass transfer is prohibited by theory. For illustrative purposes the term that accounts for a monotonic decrease is $dP/dE=-(4.46 \pm 0.58)x10^{-10}$ obtained from a parabolic least squares fit to the minima. Excluding third body effects the variation might be caused by mass and angular momentum loss from the system, perhaps by stellar wind from the low mass component or by a mechanism to account for alternate period changes in the system (Tout and Hall, 1991; Hall, 1989).

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PHOTOMETRY FOR STARS IN THE FIELD OF V BOÖTIS

V Boötis (HD 127335) is a bright and well-studied semiregular variable located near the naked-eye star γ Boötis. The extreme visual magnitude range is 7.0 to 11.3. I made photoelectric measurements of several stars near the variable in order to provide a check on the comparison sequence on an AAVSO chart for the star. The existing sequence, although tried-and-true, has not been re-evaluated since photometric scales became standardized in the post-War era. In this particular instance, the AAVSO chart magnitudes are close to the V scale for the stars I have measured.

I observed the stars using the Lowell 53cm photometric telescope on two nights with strong Moonlight, 24 & 25 June 1994 UT. Strömgren y and b filters were used through a 29-arcsec diaphragm. Each observation consisted of at least three 10s integrations on 'star' and two 10s integrations on 'sky', with greater numbers for stars fainter than about 9^m0. The bright Moonlight especially necessitated additional 'sky' readings to maintain proper signal-to-noise. Photon statistical noise was maintained above $S/N = 150$ for the faintest stars.
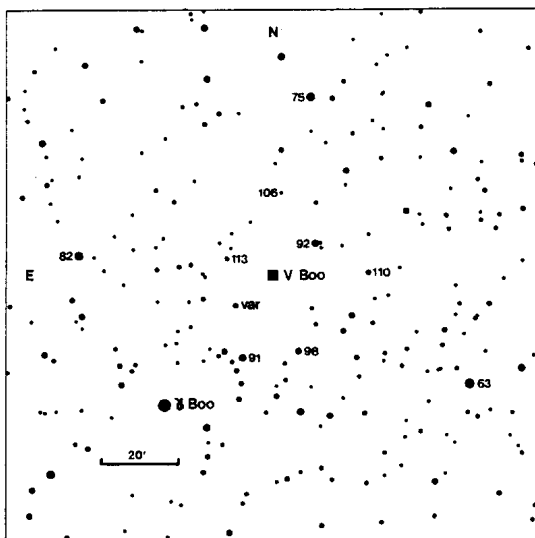

Figure 1. The field of V Boötis showing stars from the GSC brighter than 13^m.
V magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V (std)	$b-y$ (std)	V (obs)	$b-y$ (obs)	n	source
HD 113865	6.520	0.033	6.529	0.041	2	CP89
HD 120086	7.872	−0.083	7.879	−0.089	1	AT91/SP65
HD 122563⋆	6.206	0.633	6.208	0.644	2	POC/CB70
HD 122742⋆	6.273	0.452	6.284	0.441	1	O93
HD 123825	7.254	0.984	7.258	(1.007)	2	O83
HD 130970	6.165	0.868	6.163	0.885	1	O83
HD 131597⋆	8.429	0.473	8.432	0.466	2	O93
HD 136028	5.862	0.943	5.852	0.954	1	O83
HD 137006	6.113	0.155	6.110	0.166	2	O83/SP65
HD 143761⋆	5.403	0.394	5.408	0.388	4	O83/CB70
HD 145852	7.070	0.750	7.068	0.743	2	O83
HD 145936	6.452	0.617	6.447	0.608	1	O83
HD 149382	8.944	−0.142	8.937	−0.145	1	L83a/Kil
HD 154029⋆	5.283	0.002	5.287	0.005	3	O83/O93/CB70
HD 157373⋆	6.365	0.290	6.365	0.288	1	O93/O83
HD 157214⋆	5.385	0.409	5.387	0.393	2	O83/CB70
HD 160365⋆	6.128	0.374	6.130	0.367	2	O93/O83
HD 160314	7.748	0.270	(7.716)	0.277	1	O83
HD 160315	6.259	0.636	6.249	0.630	3	AT91
HD 160471	6.155	1.162	(6.182)	1.168	4	O83
HD 161817	6.982	0.137	6.977	0.132	1	L83b/CB70
HD 178233⋆	5.532	0.176	5.526	0.184	3	O83/CB70
HD 186408⋆	5.976	0.410	5.975	0.399	2	O83/CB70
HD 186427⋆	6.230	0.416	6.221	0.412	1	O83/CB70
HD 187203	6.448	0.614	(6.429)	0.617	1	O83
HD 188728⋆	5.293	0.002	5.285	0.008	2	O83/CB70
HD 190323	6.847	0.538	6.846	0.531	1	O83
HD 201094	8.250	0.804	(8.219)	0.800	1	O93

The values for the standard stars were taken mostly from the work of E. H. Olsen, supplemented by the sources cited in Table 1. Dr. Olsen has provided me with revised values for the primary four-color standards (marked with ⋆ by the star name) derived from the original standard-star list of Crawford & Barnes (1970). Table 1 shows the adopted and observed mean V and $b-y$, the number of observations 'n', and the source for the standard values. The stars are listed in RA order for equinox 2000. The data in parentheses were omitted from the transformations, mostly involving the slightly variable red stars. The mean deviations of the observed averages from the assumed values in this group of data are: $V = -0.001 \pm 0.006$; $b-y = -0.001 \pm 0.008$.

Results for the stars near V Boötis are shown in Table 2, listed in order of decreasing brightness. The mean of the two consecutive nights on V Boo itself is shown as the first entry. The stars are identified by HD, BD, or GSC number; positions come from astrometric catalogues via SIMBAD or the GSC; SIMBAD is also the source of the spectral types from the literature. The second line of each entry shows the standard deviation of

Table 2. Photometry of Stars in the Field of V Boötis

Name	RA (2000)	Dec (2000)	V	$b-y$	n	spec	Remarks
HD 127335	$14^h29^m45\overset{s}{.}2$	$+38°51'\ 41"$	9.011	1.683	2	M6e	(1)
			.006	.020			
HD 126597	14 25 29.0	+38 23 36	6.280	0.753	2	K2III:	(2)
			.011	.003			
HD 127185	14 28 55.2	+39 37 06	7.486	0.746	2	K0	
			.001	.000			
BD+39°2778	14 33 58.2	+38 56 21	8.239	1.008	2	K5	
			.009	.013			
BD+39°2774	14 30 24.5	+38 30 40	9.129	0.514	2	dK2	(3)
			.006	.000			
BD+39°2770	14 28 48.9	+38 59 44	9.166	0.453	2	K0	
			.006	.003			
BD+39°2771	14 29 12.0	+38 32 12	9.831	0.421	2	G5III	(4)
			.006	.006			
GSC 3036-0068	14 30 33.4	+38 43 55	10.593	1.281	(m5)	(5)	
			10.623	1.278			
			10.831	1.313			
BD+39°2772	14 29 34.0	+39 12 33	10.609	0.336	2	F8	
			.006	.006			
BD+39°2767	14 27 40.2	+38 52 13	10.954	0.357	2	G5	(6)
			.001	.005			
GSC 3036-0431	14 30 44.4	+38 55 52	11.327	0.332	2	(f5)	
			.004	.013			

Remarks:

(1) - = V Boo, mean values from 24 & 25 June 1994 UT.

(2) - = HR 5402. V = 6.28 (Häggkvist & Oja 1969); V = 6.27 (Walker 1971).

(3) - V = 9.124, $b-y$ = 0.508 (Garmany & Ianna 1977); spectral type from Bidelman

(4) - $b-y$ color implies spectral type near g2, likely a dwarf.

(5) = IRAS 14285+3857. The three observations were made 24 June, 25 June, and

(6) $b-y$ color implies spectral type near f8.

the means for the two nights' measures on each star. For two stars, previously published V and $b-y$ are noted in the remarks. Rough 'photometric' spectral types derived from the $b-y$ colors are indicated in lower case letters for a few stars. When the published spectral types differ considerably from those implied by the $b-y$ colors, they are also noted in the remarks.

Two stars deserve special mention: the K dwarf BD+39°2774 is nominally just outside the calibration limits of the standards, which include no dwarfs cooler than G8 ($b-y \leq$ 0.48). The present results nevertheless agree closely with those of Garmany & Ianna (1977).

GSC 3036-0068 = IRAS 14285+3857 is evidently a mid-M giant. It is marked as a suspected variable at $11\overset{m}{.}3$ on the AAVSO chart. My first two observations had larger than normal scatter, but this could be simply due to 'reduction' errors (cf. Manfroid & Sterken 1992) from extrapolating beyond the color range of the standards. (The large uncertainty in the color of V Boo almost certainly arises from this source.) I made a follow-up observation on 11 July 1994, which suggests the star is indeed variable with a range of at least a few tenths of a magnitude. The three observations are listed individually in the table. The three faintest stars in Table 2 should serve as useful comparison stars for visual observers.

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For the convenience of observers, a chart derived from the GSC is shown in Figure 1. The comparison stars are indicated by their V magnitudes rounded to the nearest tenth (decimal point omitted) in the style of visual variable- star charts. The new red variable is labelled 'var'.

I would like to acknowledge the generous assistance provided by Erik Heyn Olsen in selecting an improved set of four-color standards, and helping me define a more consistent set of stars suitable for calibrating red giants. Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France.

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PHOTOMETRY OF STARS IN THE FIELD OF S PERSEI

S Persei (BD+57°552 = HD 14528) is a member of the Perseus OB1 association, a suggestion first made by Bidelman (1947), and later confirmed via radial velocities by Humphreys (1970, 1975) and Gahm & Arkling (1971). It lies near the red, luminous limit of the MK classification system, with a mean spectral type of M4.5 Iab determined from eight-color photometry (White & Wing 1978). Slit and objective-prism classifications have ranged from M3 to M5, often showing hydrogen emission as far down as Hδ (Bidelman 1947, Blanco 1955, Gahm & Hultqvist 1972). Few other stars are known to be both as luminous (Ia at maximum) and as cool; among MK standards, only EV Carinae is similar (Keenan & Yorka 1988). The star is also a well-studied OH, SiO, and H$_2$O maser.

The star's variations have been followed visually almost continuously since they were discovered in 1872 by Krüger (1874). A summary of its early observational history is given by Campbell (1939). Even by the turn of the century, the unique nature of the light curve was evident (Turner 1904). The star exhibits long Mira-like cycles of large amplitude alternating with intervals of relative constancy. This behavior has consistently been interpreted as resulting from the beating of two interfering periods of about 810 and 950 days. The most useful analysis of this phenomenon is by Leung & Stothers (1977), which elaborates on theoretical results by Stothers & Leung (1971).

In the course of photoelectric monitoring of S Persei, in progress since October 1984, I have made a check on the existing magnitude sequence on the AAVSO (d) chart for the star. The chart magnitudes were last revised in 1952. I observed the stars using the Lowell 53cm photometric telescope. Strömgren y and b filters were used through a 29-arcsec diaphragm. Each observation consisted of at least four 10s integrations on 'star' and two 10s integrations on 'sky', with more integrations for stars fainter than about 9$^{\mathrm{m}}$0. The stars were observed in two colors on 4 January or 9 December 1993 UT. Differential y observations made on two earlier occasions were reduced to V magnitudes using the results for HD 14415 and HD 14571 determined on the later nights.

Table 1 shows the adopted and observed mean V and $b - y$ for the standard stars, and the number of observations 'n'. The stars are sorted in RA order for equinox 2000. Primary Strömgren four-color standards are indicated with $\star$ by the star name. The data in parentheses were omitted from the transformations. The mean deviations of the observed averages from the assumed values in this group of data are: V = 0.000 $\pm$ 0.005; $b - y = 0.000 \pm 0.006$.
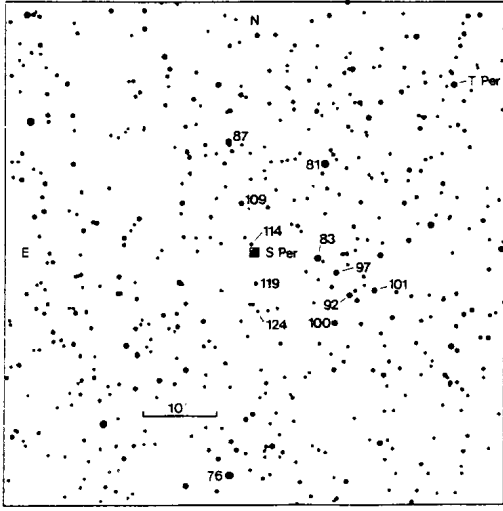
Figure 1. The field of S Persei showing stars from the GSC. V magnitudes
are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V (std)	b − y (std)	V (obs)	b − y (obs)	n
HD 4790	6.624	0.862	6.628	0.863	1
HD 6479	6.361	0.257	6.361	0.260	1
HD 6480	7.266	0.325	7.266	0.324	1
HD 11577	7.707	0.112	7.714	(0.089)	1
HD 12642	5.619	0.996	5.622	(1.021)	1
HD 13421⋆	5.635	0.358	5.640	0.363	1
HD 16901	5.436	0.566	5.433	0.564	3
HD 22211⋆	6.487	0.408	6.489	0.406	1
HD 22695	6.194	0.597	6.187	0.583	1
HD 24357⋆	5.970	0.221	5.964	0.230	2
HD 24482	8.184	1.256	8.189	1.257	4
HD 26462⋆	5.707	0.231	5.714	0.237	1
HD 33021⋆	6.165	0.397	6.167	0.389	2
HD 42049	5.929	1.044	(5.906)	1.046	1
HD 42824	6.627	0.019	6.625	0.029	1
HD 43358⋆	6.363	0.296	6.369	0.292	1
HD 45433	5.540	0.858	5.532	0.860	2
HD 47420	6.118	0.910	6.107	0.917	1
HD 52533	7.702	0.006	7.708	0.002	1
HD 57006⋆	5.915	0.339	5.913	0.333	1
HD 76494	6.133	0.610	6.132	0.603	1

Table 2. Photometry of Stars in the Field of S Persei

Name	RA (2000)	Dec (2000)	V	$b-y$	n	spec	Remarks
HD 4528	$2^h22^m51\overset{s}{.}7$	+58°35'12"	9.632	2.073	1,1	M4.5Iab	(1)
HD 14571	2 23 15.9	+58 05 18	7.616 .004	0.874 .010	4,2	KIII	
HD 14403	2 21 38.1	+58 47 03	8.140	0.724	1,1	G8III	(2)
HD 14415	2 21 45.9	+58 34 24	8.302 .002	0.684 .001	4,2	G5II	(3)
HD 14559	2 23 18.5	+58 50 04	8.705 .008	0.134	2,1	A0V	(4)
HD 14356	2 21 12.3	+58 29 27	9.212 .001	0.352	2,1	F0V	
HD 14383	2 21 26.4	+58 32 26	9.713	0.365	1,1	F5V	(5)
BD+57°548	2 21 27.8	+58 25 43	9.994 .045	0.359	2,1		
HD 14300	2 20 46.5	+58 30 03	10.095 .001	0.200	2,1	A3V	
GSC 3698-0184	2 23 05.0	+58 41 46	10.941 .002	0.289	2,1		
AG+58°256	2 22 54.8	+58 36 16	11.383 .002	0.444	2,1	A0	(6)
GSC 3698-1822	2 22 49.9	+58 30 59	11.949 .007	0.379	2,1		
GSC 3698-1966	2 22 48.1	+58 27 17	12.541 .032	0.514	2,1		

Remarks:
(1) = S Persei, measured 4 Jan 1993 UT.
(2) - = NSV 793. $b-y = 0.728$ (Olsen 1993).
(3) $b-y = 0.693$ (Olsen 1993).
(4)   V = 8.68, $b-y = 0.12$ (Pesch & McCuskey 1974).
(5) = NSV 791. includes mag. $\sim$13 companion.
(6) - = BD+57°552b.

The results for the stars near S Persei are shown in Table 2, listed in order of decreasing brightness. A single measurement on S Per itself is given as the first entry. The star positions come from the PPM and Carlsberg Meridian Circle astrometric catalogues or the GSC; spectral types were retrieved from the literature via SIMBAD. Column 'n' shows the number of measurements in V and $b-y$, respectively. For values determined on two or more nights, the standard deviation of the mean is given in the second line of each entry.

The color of S Persei lies far outside the range of the standard stars, and so the magnitude and color are subject to substantial 'reduction errors' (cf. Manfroid & Sterken 1992) as a result of extrapolating the color system defined by the standards ($0.01 < b-y <$ 1.26). Previous experience on other very red stars suggests the night-to-night jitter from extrapolating varying sets of standards to this extent results in scatter of about 0.03 – 0.05 in $b-y$, but more consistent values in V.

HD 14383 = NSV 791 was suspected of variability from visual observations by Hallowes, reported by de Roy (1935), but Hallowes notes from his series of follow-up observations that "variation must presently be considered as rather doubtful." Thus the star is not likely to be a large-amplitude variable.

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Finally, I will note that the two stars used as comparisons for the differential photoelectric measurements, HD 14415 and HD 14571, appear to be constant at the few-millimag level over the ten years I have used them.

For the convenience of observers, a chart derived from the GSC is shown in Figure 1. The comparison stars are indicated by their V magnitudes rounded to the nearest tenth (decimal point omitted) in the style of visual variable-star charts.

Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France.

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PHOTOMETRY OF STARS IN THE FIELD OF ZZ DRACONIS

ZZ Draconis (= GSC 4445-1503 = IRAS 19408+6738) is a little-studied Mira variable. Bidelman (1954) gives spectral type M7e; the period of variations lies near 275 days. The star has been on the program of the AAVSO since 1967. The magnitudes of the comparison stars on the AAVSO preliminary chart, however, are based on eye-estimates that were later found to be inconsistent. At the request of Charles Scovil, I observed several stars in the field with the aim of ameliorating this problem.

ZZ Dra has been practically unstudied following its discovery by Morgenroth (1934), who gives a position in error by $-1\!\!.\!5$ in RA and $-1'$ in Dec. His chart and that of Chernova (1951), however, are both unambiguous about the identity of the variable. Accurate positions appear in both GSC and IRAS catalogues:

Source	RA (2000)	Dec (2000)
GSC 4445-1503	$19^h40^m58\!\!.\!^s1$	$+67°46'04"$
IRAS 19408+6738	19 40 58.9	+67 46 04
Morgenroth	19 40 42	+67 45.0

I observed candidate comparison stars using the Lowell 53cm telescope on two nights with strong Moonlight, 25 & 26 June 1994 UT. The two faintest stars were observed during dark time on 11 July 1994. Strömgren y and b filters were used through a 29-arcsec diaphragm. Each observation consisted of at least three 10s integrations on 'star' and two 10s integrations on 'sky', with more integrations for stars fainter than about $9\!\!.\!^m0$. The bright Moonlight especially necessitated additional 'sky' readings to maintain proper signal-to-noise. Photon statistical noise was maintained above S/N = 100 for the faintest stars.

The values for the primary and secondary standard stars were taken mostly from the work of E. H. Olsen, supplemented by the sources listed in Table 1. Dr. Olsen has supplied me with revised values for the primary four-color standards (marked with $\star$ by the star name) derived from the original standard-star list of Crawford & Barnes (1970). Table 1 shows the adopted and observed mean V and $b-y$, the number of observations 'n', and the source for the standard values. The stars are sorted in RA order for equinox 2000. The data in parentheses were omitted from the transformations, mostly involving the slightly variable red stars, which are not primary standards. The mean deviations of the observed averages from the assumed values in this group of data are: V = 0.000 ± 0.005; $b-y$ = 0.000 ± 0$\!\!.\!$008.
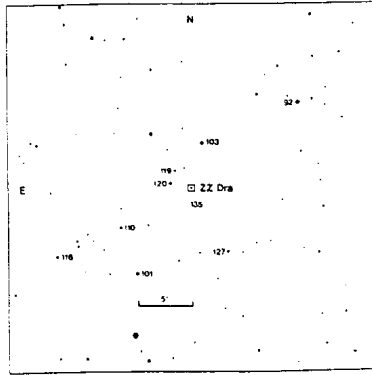
Figure 1. The field of ZZ Draconis showing stars from the GSC. V magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V (std)	$b-y$ (std)	V (std)	$b-y$ (std)	n	source
HD 113865	6.520	0.033	6.528	0.035	1	CP89
HD 122563⋆	6.206	0.633	6.208	0.641	1	POC/CB70
HD 122742⋆	6.273	0.452	6.284	0.441	1	O93
HD 123825	7.254	0.984	7.255	(1.005)	1	O83
HD 130970	6.165	0.868	6.163	0.885	1	O83
HD 131597⋆	8.429	0.473	8.428	(0.445)	1	O93
HD 136028	5.862	0.943	5.852	0.954	1	O83
HD 137006	6.113	0.155	6.114	0.165	1	O83/SP65
HD 143761⋆	5.403	0.394	5.411	0.387	2	O83/CB70
HD 145852	7.070	0.750	7.067	0.745	2	O83
HD 147266	6.043	0.595	6.044	(0.579)	1	O93
HD 149382	8.944	−0.142	8.940	−0.146	2	L83a/Kil
HD 154029⋆	5.283	0.002	5.285	0.010	3	O83/O93/CB70
HD 157373⋆	6.365	0.290	6.364	0.287	1	O93/O83
HD 157214⋆	5.385	0.409	5.388	0.397	3	O83/CB70
HD 160365⋆	6.128	0.374	6.130	0.367	2	O93/O83
HD 160314	7.748	0.270	(7.716)	0.277	1	O83
HD 160315	6.259	0.636	6.255	0.626	2	AT91
HD 160471	6.155	1.162	(6.178)	1.167	4	O83
HD 161817	6.982	0.137	6.977	0.132	1	L83b/CB70
HD 165462	6.345	0.703	(6.328)	0.701	1	AT91/O83
HD 178233⋆	5.532	0.176	5.529	0.184	3	O83/CB70
HD 186408⋆	5.976	0.410	5.978	0.398	1	O83/CB70
HD 187203	6.448	0.614	(6.429)	0.617	1	O83
HD 188728⋆	5.293	0.002	5.282	0.007	1	O83/CB70
HD 190323	6.847	0.538	6.846	0.531	1	O83

Table 2. Photometry of Stars in the Field of ZZ Draconis

Name	RA (2000)	Dec (2000)	V	$b-y$	n	spec
ZZ Dra	$19^h40^m58\overset{s}{.}1$	$+67°46'04"$	11.347	1.433	1	M7e
BD+67°1178	19 39 14.6	+67 53 52	9.174	0.736	2	K2
			.002	.002		
BD+67°1186	19 41 50.1	+67 38 09	10.052	0.615	2	G5
			.002	.013		
BD+67°1179	19 40 47.6	+67 50 13	10.265	0.365	2	
			.004	.000		
GSC 4445-1617	19 42 06.5	+67 42 24	11.008	0.359	2	
			.007	.018		
GSC 4445-0892	19 43 08.2	+67 39 43	11.575	0.370	2	
			.006	.012		
GSC 4445-1539	19 41 13.6	+67 47 39	11.945	0.293	1	
GSC 4445-1537	19 41 17.7	+67 46 30	11.953	0.444	2	
			.019	.026		
GSC 4445-0876	19 40 23.3	+67 40 12	12.729	0.501	1	
J194058+6744.6	19 40 58	+67 44.6	13.516	0.485	1	

Results for the stars near ZZ Draconis are shown in Table 2, sorted in order of decreasing brightness. A single measure of ZZ Dra itself is given as the first entry. The stars are identified by BD or GSC number (none are in the HD/HDE); positions come from the PPM and Carlsberg Meridian Circle astrometric catalogues or the GSC; spectral types were retrieved from the literature via SIMBAD. For stars observed on two nights the standard deviation of the mean values are given in the second line of each entry.

For the convenience of observers, a chart derived from the GSC is shown in Figure 1. The comparison stars are indicated by their V magnitudes rounded to the nearest tenth (decimal point omitted) in the style of visual variable- star charts.

Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France.

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PHOTOMETRY OF STARS IN THE FIELD OF VX TAURI

VX Tauri (= IRAS 04225+1626 = GSC 65-0539) is a Mira variable projected on the main body of the Hyades. It was added to the program of the AAVSO in 1984. However, the comparison stars on the preliminary chart had magnitudes based mostly on eye-estimates. At the request of Charles Scovil of the AAVSO, I made photoelectric observations of several stars in the field.

I observed the stars using the Lowell 53cm photometric telescope on four nights, 5, 7, 8, & 9 December 1993 UT. Strömgren y and b filters were used through either a 29- or 49-arcsec diaphragm. Each observation consisted of at least three 10s integrations on 'star' and two 10s integrations on 'sky', with greater numbers for stars fainter than about $9^m.0$.
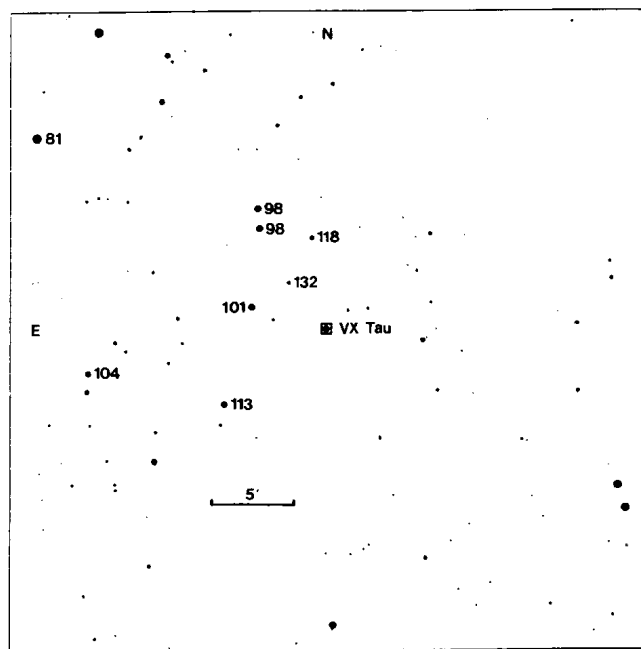
Figure 1. The field of VX Tauri showing stars from the GSC. V magnitudes
are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V (std)	$b-y$ (std)	V (obs)	$b-y$ (obs)	n	source
HD 11577	7.707	0.112	7.714	(0.089)	1	O83
HD 16901	5.436	0.566	5.441	0.562	1	O83
HD 22211⋆	6.487	0.408	6.491	0.406	2	POC/O83
HD 22695	6.194	0.597	6.186	0.584	2	O93
HD 24154	6.722	0.715	6.712	0.709	1	O93
HD 24357⋆	5.970	0.221	5.964	0.230	2	CB70
HD 24482	8.184	1.256	8.190	1.261	5	Lowell
HD 26462⋆	5.707	0.231	5.715	0.234	3	POC/CB70
HD 29063	6.072	0.855	(6.051)	0.855	1	AT91
HD 31073	9.300	0.125	9.302	0.137	1	L83/Knu
HD 32174	8.419	0.882	8.405	(0.863)	1	Lowell
HD 33021⋆	6.165	0.397	6.167	0.392	6	POC/O83
HD 35299	5.701	−0.092	5.707	−0.104	1	GO76
HD 37784	6.340	0.757	6.331	0.753	1	Lowell
HD 42049	5.929	1.044	5.930	1.051	1	HO87/Lowell
HD 42824	6.627	0.019	6.629	0.028	4	GO76/C72
HD 43358⋆	6.363	0.296	6.361	0.298	4	POC/O83
HD 44974	6.524	0.571	6.525	0.567	4	O93
HD 45433	5.540	0.858	5.528	0.861	2	AT91
HD 52533	7.702	0.006	7.701	−0.003	1	L83/HM
HD 57667	7.490	1.018	7.501	(1.037)	1	O83
HD 69994	5.808	0.696	5.808	0.694	1	Lowell
HD 73665	6.391	0.603	6.384	0.599	1	O93/CB69
HD 74721	8.715	0.029	8.711	0.035	2	AT91

The values for the primary and secondary standard stars were taken mostly from the work of E. H. Olsen, supplemented by the sources cited in Table 1. Dr. Olsen provided me with revised values for the primary four-color standards (marked with ⋆ by the star name) derived from the original standard-star list of Crawford & Barnes (1970). The "Lowell" secondary standards were observed on about thirty nights each over several seasons with the 53cm telescope directly against primary standards. Table 1 shows the adopted and observed mean V and $b-y$, the number of observations 'n', and the source for the standard values. The stars are listed in RA order for equinox 2000. The data in parentheses were omitted from the transformations, mostly involving the slightly variable red stars, none of which are primary standards. The mean residuals of the observed averages from the assumed values in this group of data are: V = −0.001 ± 0.007; $b - y$ = +0.001 ± 0.006.

Results for the stars near VX Tauri are shown in Table 2, listed in order of decreasing brightness. The stars are identified by HD, BD, or GSC number; positions come from the PPM or the GSC; SIMBAD is also the source of the spectral types from the literature. The second line of each entry shows the standard deviation of the means for the two nights' measures on each star (except HD 28099).

Table 2. Photometry of Stars in the Field of VX Tauri

Name	RA (2000)	Dec (2000)	V	$b - y$	n	spec	Remarks
HD 28099	$4^h 26^m 40^s 1$	$+16°44'49"$	8.107	0.410	1	G2+Va	(1)
HD 285794	4 25 44.0	+16 39 21	9.823 .009	0.499 .012	2	G0	
BD+16°0595	4 25 44.5	+16 40 33	9.844 .009	0.828 .006	2	G0	
HD 285795	4 25 46.0	+16 34 40	10.107 .006	0.549 .005	2	K0	
HD 285796	4 26 26.9	+16 30 47	10.403 .011	0.513 .003	2	A7	
GSC 1265-0135	4 25 52.8	+16 28 56	11.324 .030	1.483 .013	2		
GSC 1265-0941	4 25 30.9	+16 38 48	11.750 .008	1.294 .026	2		
GSC 1265-0065	4 25 36.6	+16 36 07	13.155 .035	0.664 .040	2		

Remarks: (1) = V911 Tau = van Buren 64. $b - y$ = 0.414 (Olsen 1983), 0.414 (Anthony-Twarog et al. 1991).

HD 28099 is the well-known close solar analog, 1988 MK standard (Keenan & Yorka 1988), and chromospherically-active spotted Hyades star V911 Tauri (Lockwood et al. 1984). Because the full amplitude is less than 0.05 mag., it is suitable as a comparison star for visual observers.

Interestingly, none of the fainter stars in the list is a Hyades member, and lie well in the background of the cluster, as does VX Tauri. Their $b - y$ colors suggest most or all are substantially reddened by the dark clouds in the Taurus region. Indeed, the reddest two are beyond the color range of the standards, and so the results are subject to 'reduction errors' (in this case rather small) from extrapolating beyond the system defined by the standards (cf. Manfroid & Sterken 1992). For the convenience of observers, a chart derived from the GSC is shown in Figure 1. The comparison stars are indicated by their V magnitudes rounded to the nearest tenth (decimal point omitted) in the style of visual variable-star charts.

Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France.

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PHOTOMETRY OF STARS IN THE FIELD OF AQ AURIGAE

AQ Aurigae (=IRAS 05031+3519 = GSC 2397−0319) is a poorly-studied, cool Mira with a period of about 335 days. Maxima are as bright as 8^m5 while minima are fainter than 14^m. The spectral type is in the range M6.5 to M7 according to Nassau & Blanco (1954) and Cameron & Nassau (1956). The variable was added to the program of the AAVSO in 1970. However, the comparison stars on the preliminary chart had magnitudes based mostly on eye-estimates. At the request of Charles Scovil of the AAVSO, I have made photoelectric observations of several stars in the field.

Table 1. Photometry of Stars in the Field of AQ Aurigae

Name	RA (2000)	Dec (2000)	V	$b-y$	n	spec	Remarks
AQ Aur	$5^h06^m30^s3$	$+35°23'16''$	11.135	1.814		M7	(1)
			11.113	1.832			(2)
HD 32673	5 06 29.9	+35 33 45	7.794	0.427	2	G0	(3)
			.007	.010			
HD 32682	5 06 31.7	+35 30 47	8.104	0.297	2	A0	
			.000	.001			
HD 280493	5 07 17.0	+35 41 18	9.640	0.397	1	B3e	(4)
HD 280499	5 06 37.3	+35 31 12	9.806	0.442	2	F8	
			.002	.001			
HD 280494	5 06 50.5	+35 37 49	9.907	0.313	1	A2	
HD 280498	5 05 43.4	+35 31 12	10.138	0.373	1	B2e	(5)
HD 280500	5 06 35.1	+35 17 47	10.161	0.348	2	B3	(6)
			.010	.016			
HD 280501	5 07 26.9	+35 14 58	10.182	0.490	1	F8	
GSC 2397-1095	5 06 51.5	+35 23 45	11.360	1.005	2		
			.006	.018			
GSC 2397-0760	5 06 55.8	+35 20 34	12.176	1.079	2		
			.014	.018			
GSC 2397-0953	5 06 36.4	+35 23 36	13.242	1.139	2		
			.009	.035			

Remarks:
(1) - = GSC 2397-0319. observation on 1993 Dec 5.39 UT.
(2) - observation on 1993 Dec 7.35 UT.
(3) - V = 7.799, $b-y$ = 0.437 (Olsen 1983).
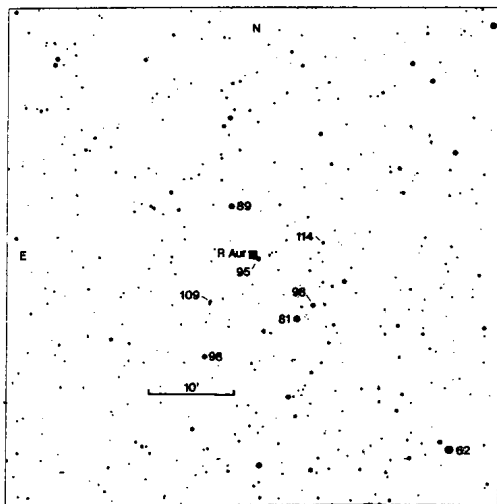(4) - = LS V +35 8.
(5) - = LS V +35 6.
(6) - = LS V +35 7.
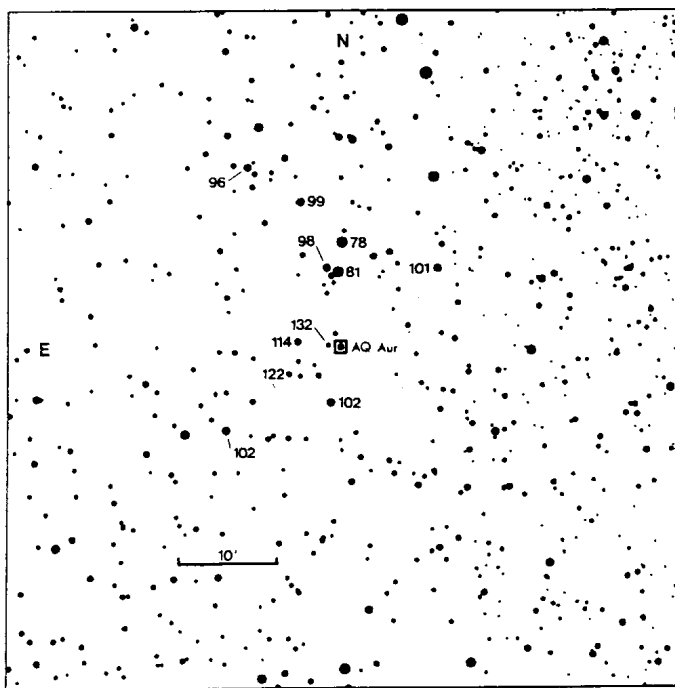
Figure 1. The field of AQ Aurigae showing stars from the GSC. V magnitudes
are indicated to the nearest tenth with the decimal point omitted.

I observed the stars using the Lowell 53cm photometric telescope on four nights: 5,
7, 8, & 9 December 1993 UT. Strömgren y and b filters were used through either a 29-
or 49-arcsec diaphragm. Each observation consisted of at least three 10s integrations on
'star' and two 10s integrations on 'sky', with greater numbers for stars fainter than about
$9^{m}_{.}0$.

The standard star set was identical to that used for the field around VX Tauri (Skiff
1994), and so the results for these will not be repeated here.

Results for the stars near AQ Aurigae are shown in Table 1, listed in order of decreasing
brightness. Measures on two nights of AQ Aurigae itself are given in the first entry. The
comparison stars are identified by HD or GSC number, with positions from the PPM,
GSC, or other sources via SIMBAD; SIMBAD is also the source for spectral types from
the literature. The second line of each entry shows the standard deviation of the means
for stars observed on two nights.

The two Be stars, HD 280493 and HD 280498, were found to exhibit $H\alpha$ emission by
Stephenson & Sanduleak (1977). These may be slightly variable, but probably only with
small amplitude.

For the convenience of observers, a chart derived from the GSC is shown in Figure 1.
The comparison stars are indicated by their V magnitudes rounded to the nearest tenth
(decimal point omitted) in the style of visual variable- star charts.

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Preparation of this report was facilitated by the use of SIMBAD, maintained by the Centre de Données astronomiques, Strasbourg, France.

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PHOTOMETRY OF STARS IN THE FIELD OF R AURIGAE

R Aurigae (= HR 1707 = HD 34019) is a bright, well-studied Mira variable with a 15-month period. The mean spectral type is about M7IIIe; maxima rise as bright as 6^m6 (visual), minima are as faint as 13^m8 (Isles & Saw 1987). The star was under visual observation by members of the BAA from 1904 until 1974; it has been on the program of the AAVSO since 1921. The period is somewhat variable, a phenomenon most thoroughly analyzed by Lloyd (1989). I observed a number of stars in the field as a check on the existing AAVSO comparison sequence, which has remained unchanged since 1928.

I observed the comparison stars using the Lowell 53cm telescope on 30 January, 25 February, and 1 March 1994 UT. Strömgren y and b filters were used through a 29-arcsec diaphragm. Each observation consisted of at least three 10s integrations on 'star' and two 10s integrations on 'sky', with more integrations for stars fainter than about 9^m0. Bright Moonlight especially on 25 February necessitated additional 'sky' readings to maintain proper signal-to-noise.

Figure 1. The field of R Aurigae showing stars from the GSC. V magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V (std)	$b-y$ (std)	V (obs)	$b-y$ (obs)	n	source
HD 11577	7.707	0.112	7.710	0.109	1	O83
HD 16082	7.236	0.701	7.235	(0.717)	1	O83
HD 23324★	5.665	−0.022	5.665	−0.016	1	O83/CB70
HD 24357★	5.970	0.221	5.973	0.225	1	Nic/CB70
HD 24482	8.184	1.256	(8.208)	1.261	3	Lowell
HD 26546	6.085	0.658	6.089	0.657	1	Lowell
HD 27749★	5.632	0.180	5.638	0.181	1	POC/CB70
HD 33021★	6.165	0.397	6.172	0.397	3	POC/O83
HD 35299	5.701	−0.092	5.715	−0.098	1	GO76
HD 41143	7.757	0.720	7.763	0.732	1	GO91
HD 42131	7.059	0.614	7.061	0.620	1	GO91
HD 42049	5.929	1.044	(5.951)	1.057	1	Lowell
HD 42398	5.821	0.683	5.815	0.683	1	Lowell
HD 42824	6.627	0.019	6.621	0.030	2	GO76/C72
HD 43358★	6.363	0.296	6.368	0.298	1	POC/O83
HD 44974	6.524	0.571	6.524	0.570	1	O93
HD 45433	5.540	0.858	5.541	0.850	1	AT91
HD 47420	6.118	0.910	6.120	0.922	1	AT91/O83
HD 48805	6.497	0.543	6.499	(0.526)	2	O93
HD 50188	9.539	0.010	9.544	(−0.012)	1	L92/Lowell
HD 52533	7.702	0.006	7.693	0.000	1	L83/HM
HD 57006★	5.915	0.339	5.914	0.336	2	GOS/O83
HD 58580	6.781	−0.003	6.782	−0.004	2	O83
HD 60803★	5.902	0.376	5.902	0.376	3	O83
HD 73665	6.391	0.603	6.387	0.597	4	O93/CB69
HD 73666	6.618	0.005	6.610	0.004	3	CB69
HD 74721	8.715	0.029	8.713	0.027	2	AT91/S91
HD 79248	6.480	0.017	6.490	0.017	1	Nic/C72
HD 85217★	6.236	0.305	6.234	0.307	1	GOS/O83
HD 86238	7.272	0.815	7.268	(0.803)	1	Lowell
HD 88923	7.699	0.266	7.698	0.261	1	O83
HD 98280	6.660	0.024	6.663	0.034	1	Nic/C72
HD100600★	5.948	−0.070	5.952	−0.076	1	POC/CB70
HD101606★	5.744	0.312	5.745	0.310	1	O83
HD103095★	6.429	0.484	6.425	0.487	1	O83/CB70
HD107655	6.200	−0.002	6.192	−0.001	1	Nic/C72
HD109995	7.600	0.048	7.602	0.045	1	Nic/CB70
HD113865	6.520	0.033	6.519	0.039	1	CP89

Table 2. Photometry of Stars in the Field of R Aurigae

Name	RA (2000)	Dec (2000)	V	$b-y$	n	spec	Remarks
HD 34019	$5^h17^m17\!.\!7$	$+53°35'10"$	10.568	2.289		M7IIIe	(1)
			10.228	2.170			(2)
HD 33654	5 14 44.3	+53 12 50	6.153	0.109	2	A0V	(3)
			.007	.000			
HD 33941	5 16 42.9	+53 27 53	8.054	0.735	2	K0	
			.000	.007			
HD 233098	5 17 34.6	+53 40 45	8.923	0.624	2	K0	
			.006	.001			
HD 233095	5 17 13.6	+53 34 43	9.492	0.324	2	F4IV	(4)
			.001	.001			
BD+53°0885	5 17 54.7	+53 23 32	9.802	0.864	2		(5)
			.036	.004			
GSC 3735-0918	5 16 30.4	+53 29 27	9.847	0.801	2		
			.013	.001			
GSC 3735-1121	5 17 50.5	+53 29 49	10.865	0.391	2		
			.012	.018			
GSC 3735-1310	5 16 23.0	+53 36 36	11.411	0.197	2		
			.023	.062			

Remarks:

(1) = R Aurigae = HR 1707; observation on 1994 Jan 30.24 UT.

(2) - observation on 1994 Feb 25.22 UT.

(3) = HR 1692. V= 6.20 (Oja 1983), 6.16 (Oja 1991), $b-y$ = 0.094 (Crawford et al. 1972).

(4) - V = 9.50 and spectral type (Lutz & Lutz 1977).

(5) = GSC 3735-1156. possibly slightly variable.

The values for the primary and secondary standard stars were taken mostly from the work of E. H. Olsen, supplemented by the sources listed in Table 1. Dr. Olsen has supplied me with revised values for the primary four-color standards (marked with ⋆ by the star name) derived from the original standard-star list of Crawford & Barnes (1970). The "Lowell" secondary standards were observed on about thirty nights each over several seasons with the 53cm telescope directly against primary standards. Table 1 shows the adopted and observed mean V and $b-y$, the number of observations 'n', and the source for the standard values. The stars are sorted in RA order for equinox 2000. The data in parentheses were omitted from the transformations, mostly involving the slightly variable red stars, which are not primary standards. The mean deviations of the observed averages from the assumed values in this group of data are: V = +0.001 ± 0.005; $b-y$ = +0.001 ± 0.006.

Results for the stars near R Aurigae are shown in Table 2, sorted in order of decreasing brightness. Two measures of R Aurigae itself are given in the first entry. The stars are identified by HD, BD, or GSC number; positions come from the PPM and Carlsberg Meridian Circle astrometric catalogues or the GSC; spectral types were retrieved from the literature via SIMBAD. The standard deviation of the mean values are given in the second line of each entry.

The color of R Aurigae is of course far outside the range of the standards, and so the results are subject to 'reduction errors' from extrapolating the calibrations defined by the standards (cf. Manfroid & Sterken 1992). Previous experience suggests the uncertainties arising from this source are ±0.03 to 0.05 mag. in $b-y$, with smaller errors in V.

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For the convenience of observers, a chart derived from the GSC is shown in Figure 1.
The comparison stars are indicated by their V magnitudes rounded to the nearest tenth
(decimal point omitted) in the style of visual variable- star charts.

Preparation of this report was facilitated by the use of SIMBAD, maintained by the
Centre de Données astronomiques, Strasbourg, France. It was also helpful to have at
hand a copy of "The Bright Star Catalogue", 5th revised edition (March 1994), by D.
Hoffleit and W. H. Warren, Jr., kindly supplied by Wayne Warren.

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THE OBSERVATION OF SUPERHUMPS IN AY LYRAE

AY Lyr, an SU UMa type dwarf nova experienced a superoutburst in June 1 - 16. 1994. Figure 1 shows the long-term visual light curve around this superoutburst. The abscissa is Julian Day minus 2400 000. 49 505 corresponding to June 1, 1994. The big arrow indicates the epoch of our observation. The smaller arrows indicate upper limits. The variability is characterized by a precursive normal outburst, followed by a usual course of a superoutburst. We designed this observation to investigate the rôle of precursor in the development of superhumps.

Our observation was performed on June 3, 1994 using a CCD camera (Thomson, TH7882 CDA, 576×384 pixels with 23 μm square pixel size) attached to the Cassegrain focus of 0.6-m reflector at Ouda Station, Kyoto University (Ohtani et al.,1992). The mode of 2×2 on-chip summation was employed. The observation was done for about five hours interrupted for 30 min with Thomson V-band filter. The exposure time was 90 sec with read-out dead time of 13 sec.

We reduced the data using the personal-computer-based aperture photometry package developed by one of the authors (T.K.). This package automatically subtracts bias-flames, applies flat fielding and enables us to estimate the instrumental magnitudes. The aperture size was 8" in radius. The sky level was determined from pixels whose distance from the individual objects are between 16" to 30".

Figure 2 shows the short-term light curve of differential magnitude between AY Lyr and a comparison star whose magnitude is 13.0. Using a nearby check star we confirmed the constancy of the comparison star within $0^{m}01$. Table 1 shows the details of the comparison star and the check star from Guide Star Catalogue (GSC). The expected error for one mesurement of the differential magnitude is about $0^{m}01$.

We analyzed the light curve using PDM (Stellingwerf 1978) program within IRAF package (IRAF is distributed by National Optical Astronomy Observatories, U.S.A.). Figure 3 shows the Θ diagram, whose abscissa is frequency(day^{-1}). The lowest minimum point in Θ corresponds to 108.5 minutes. For the estimation of error, another period analysis was made. We smoothed the light curve and took the maxima and the middle of rising stages. From the distances between two adjacent points with the same phase we get the periods. The average of the periods was 109.2 min and the standard deviation was 1.2 min. The value determined by PDM is within the estimated error. Since we used all data in our PDM analysis, PDM gives a better estimate of the period. So we take 108.5 ± 1.2 min as the best estimate of the superhump period and its error. There are some published values; the one is 108.8 min (Patterson 1979), the other, 109.4 (Udalski and Szymanski 1988, Ritter 1990). The period we found is clearly consistent with them.
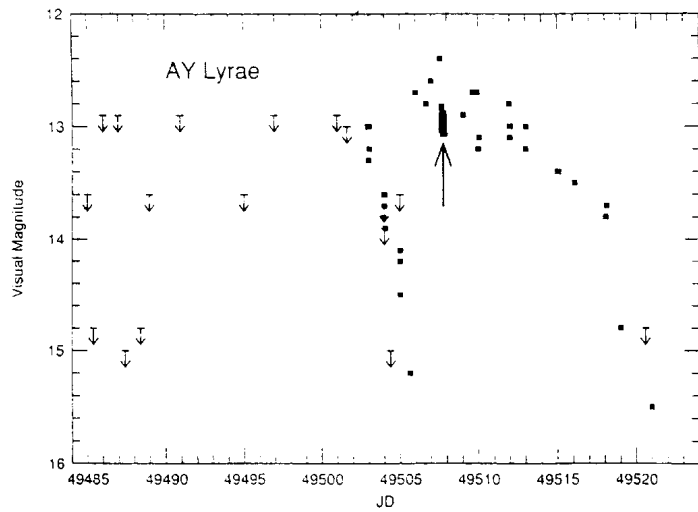
Figure 1: Long-term light curve around this superoutburst
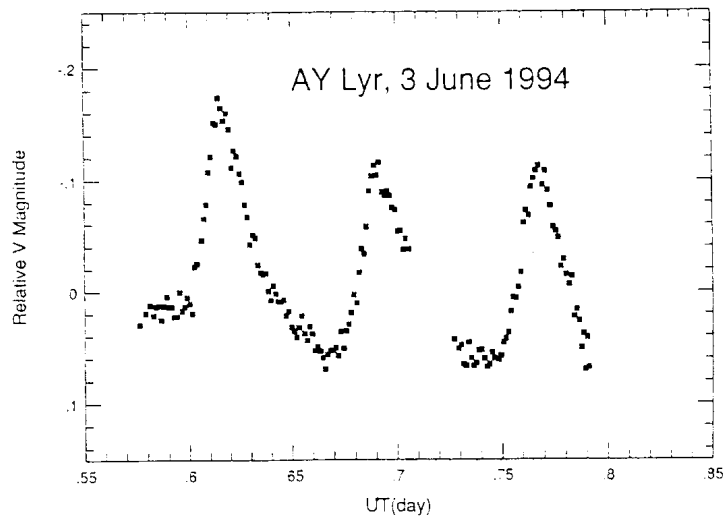
Figure 2: Short-term light curve of differential magnitude of AY Lyr

Table 1: Details of the comparison star and check star from Guide Star Catalogue

	GSC number	$\alpha_{2000.0}$	$\delta_{2000.0}$	magnitude
comparison	3118 01482	$18^h44^m15^s.84$	$+38°00'26''.8$	13.0
check	3118 01147	$18^h44^m22^s.43$	$+37°55'17''.2$	12.0
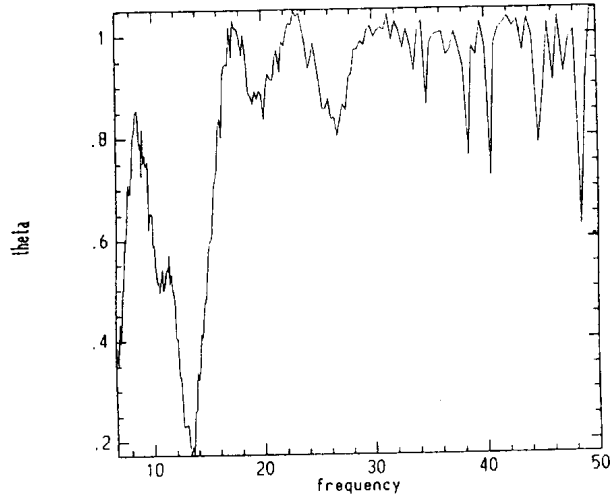
Figure 3: The Θ diagram
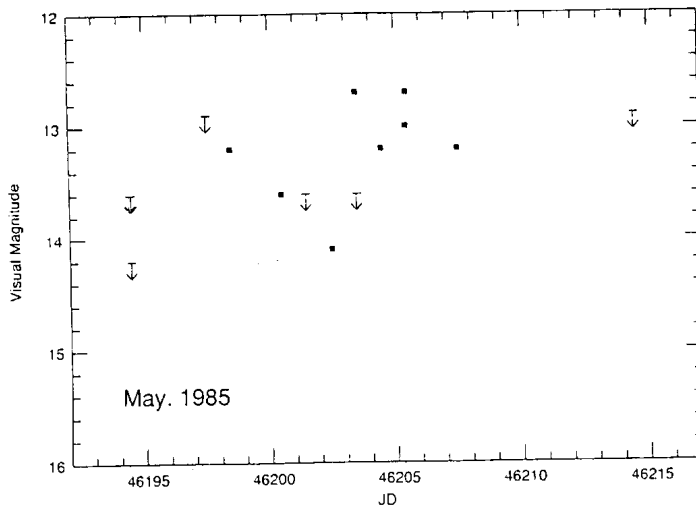
Figure 4: Light curve of a previous superoutburst

Some discussions are as follows:

- The superhumps had already developed fully within two days after the onset of the superoutburst, although it usually take three days or more to develop superhumps. It implies that the accretion disk had been processed by tidal force before the beginning of the superoutburst, i.e. in the precursive outburst phase.

- Tonny Vanmunster supplied us the data of 12 previously observed superoutbursts, one of which shows a superoutburst with a precursor similar to our present observation (see Figure 4).

In conclusion, the appearance and development of superhumps should be more systematically surveyed in such "precursor-superoutburst" complex.

The authors are grateful to the members of Variable Stars Observer League in Japan (VSOLJ), H. Bengtsson, T. Vanmunster, G. Poyner, V.Michel, P. V. Cauteren, A. Diepvens, J. Pietz and L. Teist, for supplying us the magnitude estimation. Thanks are also to H. Bengtsson and T. Vanmunster, for providing their compilations of previous observations of AY Lyrae. We thank S. Mineshige, for useful comments and H. Baba, for assistance in this observation.

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NEW PHOTOELECTRIC LIGHT CURVES OF
VZ CANUM VENATICORUM

The variability of VZ CVn was discovered by Strohmeier and Knigge (1960), who reported it to be a short-period variable star with an amplitude of 0^m7. In 1962 Strohmeier, Knigge and Ott determined that VZ CVn was a β Lyrae system with a deep secondary minimum. From 22 epochs of primary minimum and 13 epochs of secondary minimum, they derived the light elements:

$$\text{Min.I} = JD_\odot 2426002.700 + 0^d8424635 \times E \qquad (1)$$

In 1965 Oburka reported three epochs of primary minimum for VZ CVn obtained with binoculars. The first photoelectric light curves in BV bands were obtained in 1965 by Harris (1968), who got 2 epochs of primary minimum and 2 epochs of secondary minimum. The epochs of these minima and the minima of other observers, together with the weights assigned to them are processed with the aid of the least squares method. The improved light elements are:

$$\text{Min.I} = JD_\odot 2426002.6956 + 0^d84246261 \times E \qquad (2)$$

In 1971 and 1972 VZ CVn was observed photoelectrically by Ibanoğlu (1974) in BV bands, he observed 4 primary and 5 seondary minima. The epochs of these minima and the minima of Harris and other observers were used together to determine improved light elements by the method of least squares:

$$\text{Min.I} = JD_\odot 2438880.5807 + 0^d84246150 \times E \qquad (3)$$

In 1972 Pohl and Kizilirmak reported 13 epochs of minima separately for each color, in 1974 they published 2 epochs of minima, in 1977 they gave an epoch of minimum again. From 1971 to 1976 Cester, Mardirossian and Pucillo (1977) observed VZ CVn in UBV bands, 22 new epochs of minimum were deduced separately for each color from the observations. All photoelectric minima were taken into account for a re-determination of the light elements by means of least squares method, giving the same weight to the single epochs and considering only the mean value of their U, B and V minimum. The new light elements are

$$\text{Min.I} = JD_\odot 2438880.5804 + 0^d84246163 \times E \qquad (4)$$

The present observations of VZ CVn were made in BV bands on 7 nights from 1993 to 1994 with photoelectric photometer attached to 1m reflecting telescope at Yunnan Observatory, the comparison star and the check star are the same which have been used by the previous observers: BD+29°2417 and BD+29°2409 respectively. The new light curves (612 points in B and 610 points in V band) are displayed in Figures 1 and 2, all the observational data have been corrected for the atmospheric extinction. The new light curves were found to be variable near the maxima similar to the observations of previous observers. In addition, the new light curves showed some pulsational variations near the
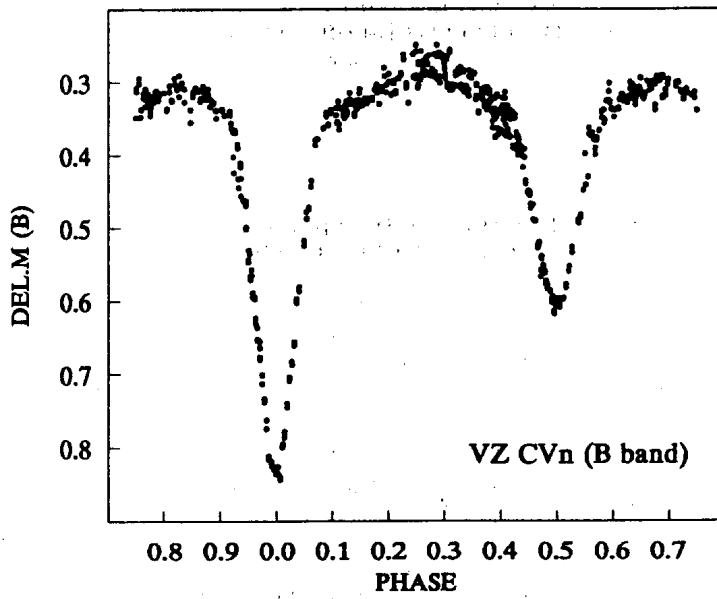
Figure 1. The light curves of VZ CVn in B band
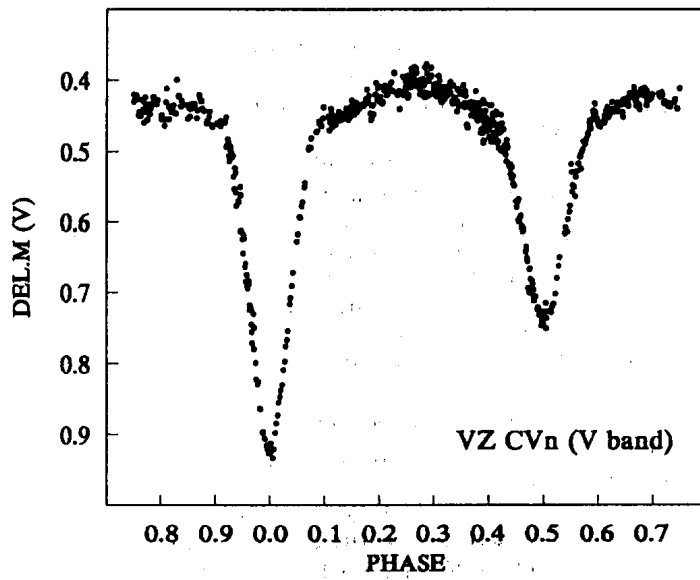
Figure 2. The light curves of VZ CVn in V band
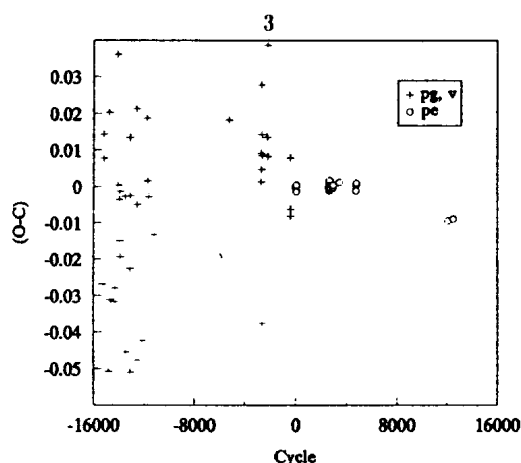
Figure 3. The O−C diagram

maxima. From our observations an epoch of primary minimum and an epoch of secondary minimum were calculated and are listed in Table 1. In this table the O−C residuals were computed according to Cester et al.'s light elements.

We collected all minima available, in order to calculate the O−C residuals using formula (4). The O−C diagram is plotted in Figure 3. From this diagram a systematic trend, i.e. decreasing period of VZ CVn is suspected. This is also seen when comparing formulae (1) and (3). The detailed analysis of this system will be published elsewhere.

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    No. 13

NEW TIMES OF MINIMUM FOR V444 CYGNI

The importance of the binary system V444 Cyg lies in the way it tells us so much about Wolf-Rayet stars (Cherepashchuk et al. 1984; St-Louis et al. 1993). The mutual eclipses of its WN5 and O6 components determine the structure of the wind of a WR star with a known mass and size. Furthermore, the rate at which the orbit of this binary system increases determines the mass loss rate of the WR star, provided some assumptions are made about the wind. Khaliullin (1974) first pointed out that impulsive isotropic mass loss from a component of a binary will produce a steady period increase and used this effect to determine a mass loss rate near 10^{-5} $M_\odot$/yr in V444 Cyg. Khaliullin et al. (1984) have refined the estimated mass loss rate further, while more recently Underhill et al. (1990) have added a few more times of minimum and argued for a somewhat smaller mass loss rate.

Table 1. Recent Times of Minimum Light

HJD	Type	O-C	Source
2,444,913.424 ± 0.004	pri	0.017	Eaton et al. (1982)
2,444,915.526 ± 0.004	sec	0.016	Eaton et al. (1982)
2,445,528.460 ± 0.003	pri	0.040	Underhill et al. (1990)
2,445,972.860 ± 0.006	both	0.032	this paper-KPNO
2,447,394.562 ± 0.006	pri	0.034	Underhill et al. (1990)
2,447,767.405 ± 0.006	sec	0.076	St-Louis et al. (1993)
2,447,773.678 ± 0.006	pri	0.031	Underhill et al. (1990)
2,449,519.78 ± 0.01	sec	0.078	this paper-APT
2,449,540.830 ± 0.002	sec	0.066	this paper-APT

We have decided to begin measuring times of minimum to determine whether the period continues to increase. We are concentrating on <u>secondary</u> eclipse, the eclipse

V444 Cyg–Secondary Minimum

HJD − 2,449,000
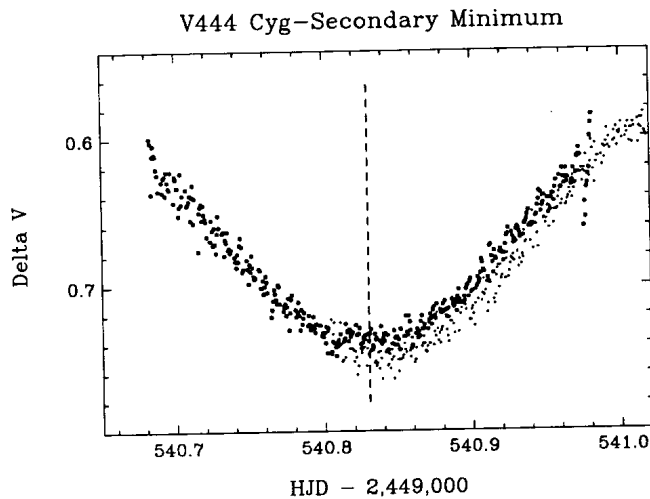
Figure 1. Observations of secondary eclipse of V444 Cyg made with the Vanderbilt-TSU robotic telescope. Magnitude differences are measured with respect to HD 193514, the standard comparison star. Two eclipses are plotted, one centered on JD 2,449,540 (large symbols) and another on JD 2449519 (small dots) moved forward by an integral number of cycles. The effect of morning twilight is seen in the large scatter at the end of the former night. The latter light curve is fainter by about 0.02 mag at all phases sampled, a typical photometric complication in this star. The dashed vertical line is the time of minimum light found from the later of these two eclipses.

of the WR star by the O6 star, because it is shorter and less likely to be affected by fluctuations in the WR wind. To this end we obtained differential photometry in B and V on two nights in summer, 1994, with the 16-inch Vanderbilt-Tennessee State robotic telescope (Henry and Hall 1994). Figure 1 gives the observed light curve in V. The time of minimum (combination of values from B and V) for the night that detected both ingress and egress was HJD 2,449,540.830 ± 0.002. We have determined a second time of minimum for the earlier partially observed secondary eclipse (small symbols in Figure 1) by fitting an average profile for secondary eclipse, determined by Cherepashchuk and Khaliullin (1973), to the observations in hand, viz., HJD 2,449,519.78 ± 0.01. A third time of minimum (HJD 2,445,972.860 ± 0.006) is found by simultaneously fitting the rising branch of primary minimum and falling branch of secondary minimum recorded
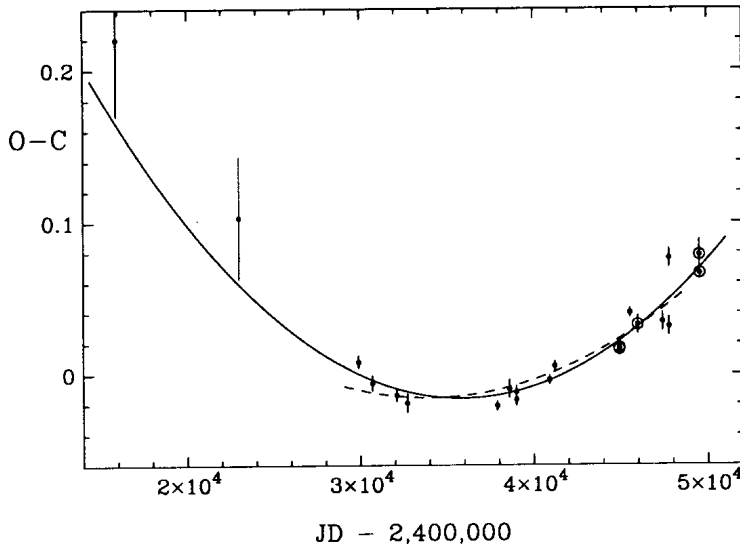
Figure 2. Residuals from a linear ephemeris for all available times of minimum of V444 Cyg. The new and ignored points from Eaton are circled. The solid curve is fitted by least squares to the residuals. The dashed curve is the fit to the points considered by Underhill et al. (1990).

in a partial V-band light curve we obtained in 1984 at Kitt Peak National Observatory (see Breger 1985, file 118). In addition, there are two obscure times of minimum that Eaton et al. (1982) obtained with the IUE satellite, another time of secondary minimum from St-Louis et al. (1993), and the three times of primary minimum from Underhill et al. (1990).

All these recent times of minimum are listed in Table 1, along with deviations from the linear ephemeris of Khaliullin (1974),

$$HJD(Obs.) \; = \; 2,441,164.337 \, + \, 4.212435 \times E \qquad\qquad (\,1\,)$$

We combine them with those of Khaliullin et al. (1984) in Figure 2. Our new residuals are seen to be following the trend toward longer periods expected for continuous mass loss. The rate of change derived by including the new times of minimum is greater than found by Underhill et al., but it is still somewhat smaller than originally derived by

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Khaliullin et al. The rate of period change is $\dot{P} = 3.84 \pm 0.19 \times 10^{-9}$ days/day. If we adopt the masses of Underhill et al. (1988), $M_{WR} = 11.3 \, M_\odot$ and $M_o = 37.5 \, M_\odot$, this period increase corresponds to $\dot{M} = 8.1 \pm 0.4 \times 10^{-6} \, M_\odot/yr$ for isotropic mass loss by the WR star. Uncertainties in the masses now appear to be critical to the mass loss rate, for the recent masses of Marchenko et al. (1994), $M_{WR} = 9.3 \, M_\odot$ and $M_o = 27.8 \, M_\odot$, give $6.2 \times 10^{-6} \, M_\odot/yr$.

An indication of the quality of the data obtainable with an automatic telescope is the clearly defined times of second and third contact evident in Figure 1. The third contact is seen in both nights' data. This effect would be much more difficult to detect in manual differential photometry with its lower data rate.

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1993 BVRI PHOTOMETRY OF BH VIRGINIS

BH Virginis (# 117 in the catalog of Strassmeier et al. 1993) is a member of the short period eclipsing RS CVn class of stars. Budding and Zeilik (1987) first modeled the spots on this star. Zeilik et al. (1990) modeled the spot structure for available data from 1953 to 1986. However, BH Vir has been observed too infrequently during this time period to provide information on the spot evolution. We therefore started a program to systematically observe BH Vir.

We observed BH Vir on the nights of 22, 24, 25, 26, 27, 28, 29, and 30 July 1993 using the San Diego State University 61-cm telescope on Mt. Laguna. The telescope is equipped with a photometer using a Hamamatsu R943-02 tube operated at -1450V and cooled to -15°C. The BVRI filters are chosen to closely match the Johnson Cousins system. Our comparison star was star 0476 in region 4968 of the Hubble Guide Star Catalog. July is rather late in the observing season for BH Vir, so we were only able to observe it for a short time each night. Therefore our light curves have only 60 points, and contain significant gaps. We do however have enough data to model the spots. Our data, plotted in Figures 1 and 2, are differential magnitudes (star-comparison) in the standard Johnson Cousins system.

To model the data, we used the Information Limit Optimization Technique (ILOT) described in detail by Budding and Zeilik (1987). From the initial binary star fits we extract a distortion wave. We then fit the distortion wave for the longitude, latitude, and radius of circular spots at 0K. The fits for each wavelength are performed independently. We get:

	B band	V band	R band	I band
Longitude	282.5±4.9	271.4±5.3	281.9±6.7	278.7±6.4
Latitude	81.7±0.8	80.5±0.9	83.1±0.9	83.0±0.8
Radius	38.2±0.5	34.1±0.5	35.1±0.5	35.6±0.5
χ^2	84.36	56.1	50.1	51.8

Figures 3 and 4 show our initial binary star fit and our spot fit for the V band. Note that the models in the different bands agree well. Zeilik et al. (1990) find that the spots for BH Vir tend to cluster in Active Longitude Belts at 90° and 270°. Our models show the same phenomenon, with the spot being in the 270° ALB. It is difficult to be certain because many latitudes were adopted values, but the spot models of Zeilik et al. (1990) tend to be at mid latitudes (~45°) and about 10° in radius. Our 1993 models show a much larger high latitude

BH VIRGINIS - 1993
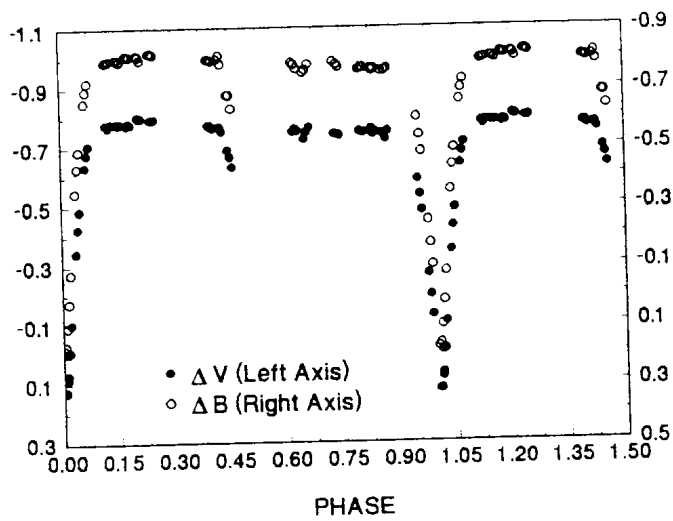
Figure 1

BH VIRGINIS - 1993

Figure 2

BH VIRGINIS - 1993

V BAND INITIAL FIT

Figure 3

BH VIRGINIS - 1993

V BAND SPOT FIT
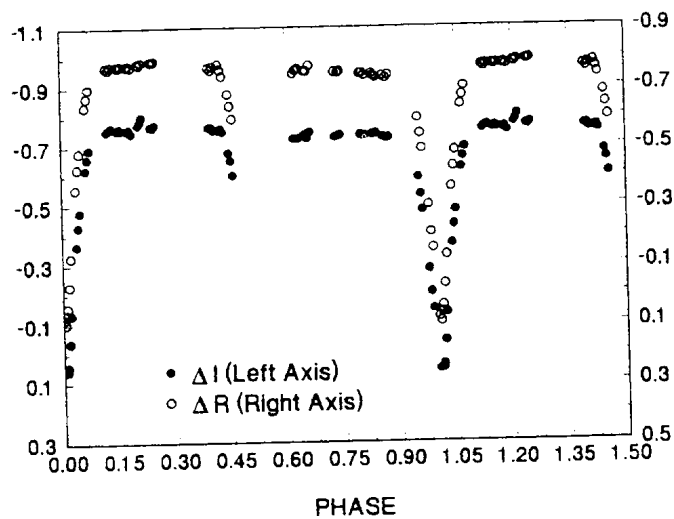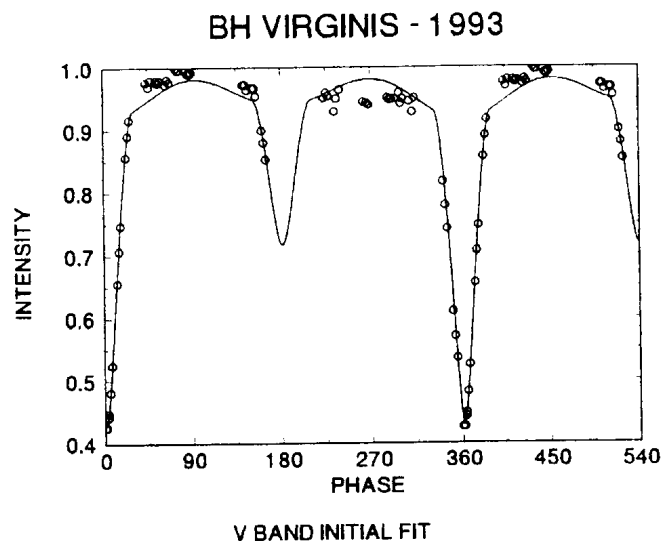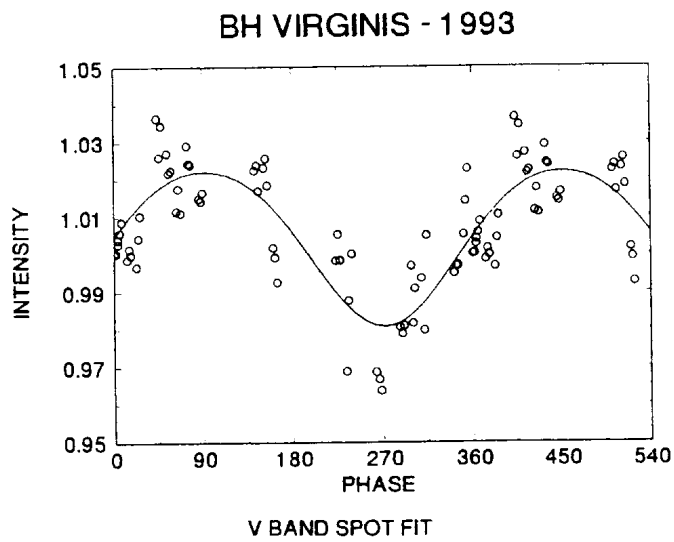
Figure 4

spot, indicating that the spots on this star can vary considerably in latitude. Consistent observations over a longer time period are needed to unravel the behavior patterns of the spots on this system.

We thank Ron Angione for scheduling generous amounts of observing time at Mt. Laguna. PAH received support from the Research Corporation for this work.

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CHROMOSPHERIC INACTIVITY OF δ CORONAE BOREALIS IN 1991-93

δ CrB (HR 5889) is a chromospherically active giant of spectral type G5 III-IV. In 1985/86 (Fernie 1987) it showed a sinusoidal variability of about 0.06 mag in V and period about 45 days. This variability persisted in 1987 and 1988, but the period increased at the remarkable rate of some 10 days per year and was accompanied by changes in the amplitude and overall light level (Fernie 1989, 1990). In 1989 the activity ceased, but returned in 1990 with a period of 61 days and amplitude 0.04 mag (Fernie 1991). These effects were interpreted as due to a large spot or spot group drifting in the photosphere of δ CrB.

I have continued to monitor δ CrB by means of a program with the Automatic Photoelectric Telescope Service, and since the last reported observations to JD 2448145 have accumulated another 353 nights of UBV photometry through the 1991, 92, and 93 seasons. Plots of these data show that through most of this interval δ CrB showed no significant variability, although between JD 2448710 and 2448810 (April - August 1992) there was a weak 0.02 mag variation of period 49 ± 2 days. As Table 1 shows, there was no detectable change in the overall light level during these three seasons. (Cf Fig.3 of Fernie 1990.)

Table 1
MEAN SEASONAL VALUES

Year	<V>	s.e.
1991.289	4.632	±0.001
1992.316	4.634	±0.002
1993.327	4.633	±0.001

It is of some interest that the standard deviations of the V magnitudes in each of the three seasons were 0.008, 0.020, and 0.008 mag respectively. The second value (1992) no doubt reflects the presence of some variability, but the 0.008 mag for 1991 and 1993 sets an upper limit for the average observational error of the APT data at this apparent magnitude.

I do not propose publishing the individual data, but will gladly supply them to anyone who wants them. Contact me at fernie@astro.utoronto.ca on the Internet.

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ERRATUM

Upon Prof. Bidelman's suspicion, it turned out that the new variable star reported in IBVS No. 3612 had been misidentified. The new small amplitude variable is HD 111829 (instead of HD 111828, as stated in the discovery note).

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HIC 83921: A NEW PULSATING STAR IN HERCULES

During the photoelectric observations of the close binary system AK Herculis carried out in the summer 1993 at the stations of Capanne di Cosola (AL, Italy) and Castelnuovo Bormida (AL, Italy) the variability of the comparison star HIC 83921 (SAO 102617) was strongly suspected. After a close scrutiny of the available data, it was clear that HIC83921 was subjected to fast light variations.

The availability of the appropriate measurements of the check star HIC 83855 carried out during five nights (from 15 to 24 July 1993) as well as the sky background permitted to get a set of 772 differential photometric instrumental V data of the new suspected variable star. Additional photometry in June 1994 at Castelnuovo Bormida added a set of new 200 data points always in the instrumental V band.

The comparison star was HIC 83855 (SAO 102611) and the check one was HIC 83810 (SAO 102607) for the data set gained in 1994, while the ones obtained during the year 1993 were processed adopting HIC 83855 (SAO 102611) as comparison star.

The standard data for these stars are reported in Table 1. The whole photometry of HIC 83921 was carried out by a 200mm Schmidt-Cassegrain f15 telescope equipped with a photoelectric photometer Optec SSP5 (Spectral Sensitivity S5) operating in the Johnson-Morgan standard B and V bands. The adopted integration time was fixed to ten seconds.

Additionally a number of photoelectric observations of V463 Herculis, a variable star very near to HIC 83921, were also carried out in order to exclude at all a possible mistake in the identification of the new variable star.

Since this work is preliminary, here we limit us to search for the best phasing preliminary period. Eventual analysis in order to ascertain the existence of two (or more) pulsation periods will be postponed to a subsequent work. In order to get at least a preliminary value for the period we carried out spectrum analysis of the whole data set by Recursive Fourier Techniques making also appropriate analysis of the Spectral Window Function.

In order to get the clean spectrum we deconvolved the spectral window from the original power spectrum using the well known CLEAN technique (Roberts et al., 1987) obtaining a two peaked clean spectrum. Additionally a periodogram using the Generalized Phase Dispersion Minimization method (GPDM) (Gaspani, 1993b) was computed. This procedure does not assume any particular data fitting function so it is very efficient when the search signal is not sinusoidal. The generalized periodogram graphed in Figure 1 shows two peaks corresponding to frequencies $f_1=7.77$ and $f_2=7.91$ cycles/day. The frequency $f_1=7.91$ cycles/day dominates the first one, so we assumed it as preliminary true frequency. This implies a period P=0.1264 days.

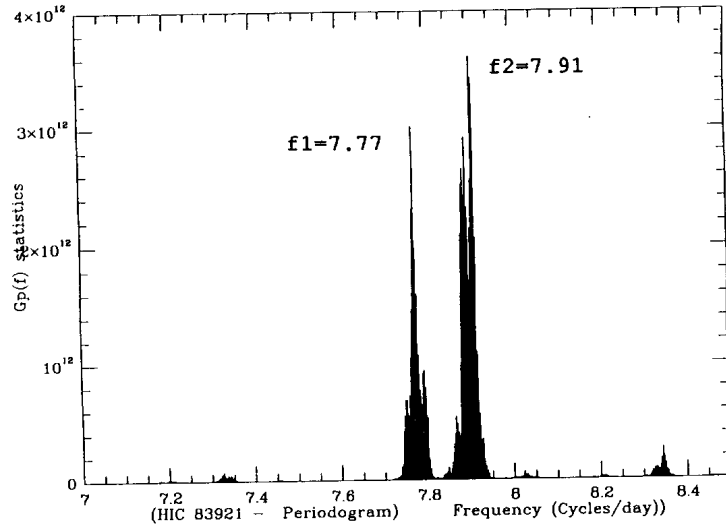Similar results were obtained with the CLEAN deconvolution technique.

Figure 1. Periodogram of the whole data set showing two
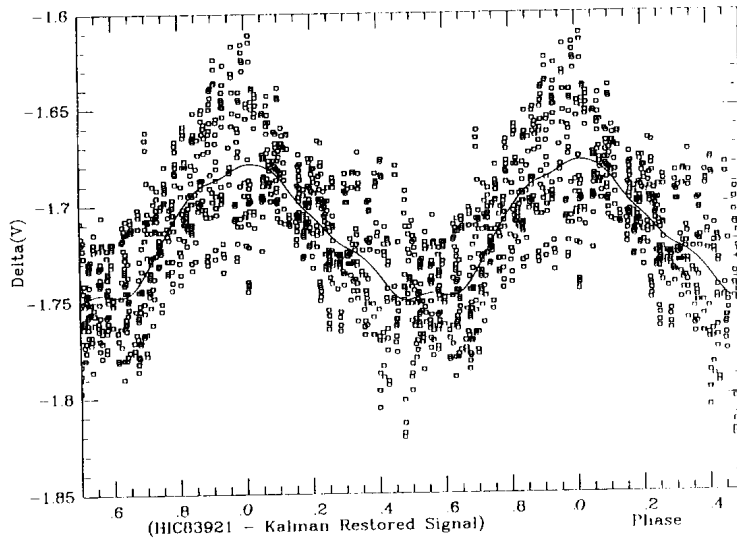dominating frequencies: $f_1 = 7.77$ and $f_2 = 7.91$ cycles/day

Figure 2. HIC 83921 – Photoelectric V data phased using the light elements
listed in text (squares). The solid line is the restored light curve.
The adopted restoration technique is based on the Scalar Kalman Filter.

Table 1. Data of the involved stars

HIC 83855 (SAO 102611=BD+16°3102=HD 154974)
$\alpha(2000)=17^h08^m15^s728$ $\delta(2000)=+16°15'37''89$
V=7.300±0.030   B−V=0.590±0.020
Spectral type F8 IV

HIC 83810 (SAO 102607=BD=+15°3116=HD 154892)
$\alpha(2000)=17^h07^m41^s319$ $\delta(2000)=+15°12'37''57$
V=7.890±0.031   B−V=0.516±0.015
Spectral type: F8 V

HIC 83921 (SAO 102617=BD+16°3105=HD 155118)
$\alpha(2000)=17^h09^m04^s91$ $\delta(2000)=+16°27'43''80$
V=8.389±0.031   B−V=0.392±0.012
Spectral type: F0

Table 2. HIC 83921 – Heliocentric times of maximum

JD 2449184.4572±0.0004
JD 2449191.421 ±0.002
JD 2449191.5408±0.0003
JD 2449510.5101±0.0007

Table 3

Epoch E	Observed time of maximum	Computed time of maximum	Residual (O−C)
0	184.4572	184.4619	−0.0047
55	191.4210	191.4153	+0.0057
56	191.5408	191.5417	−0.0009
2579	510.5101	510.5103	−0.0002

In order to refine the preliminary period found, four heliocentric times of maximum were computed using the available observations. The heliocentric times of maximum were computed using the available observations. The heliocentric times of maximum obtained by the Minimum Entropy SOP method (MEMSOP, Gaspani 1993a) are listed in Table II. On the basis of the four available times we obtained the following least squares fit:

$$\text{Maximum}=\text{J.D.(hel) } 2449184.462 + 0^d126424\times E$$
$$\pm0.003 \quad \pm 0.000002$$

that is the first ephemeris for the studied variable star. The comparison with the observations is shown in Table 3. Figure 2 shows the phased light curve composed by all the available data points and obtained using the ephemeris listed above.

In order to recover a convenient estimate of the true signal from the noisy data we processed the noisy phased data by a signal restoration technique based on the Kalman Filter Theory (Gaspani, 1993c). Figure 2 shows the restored light curve, graphed as a solid line, across the original data points. Evidently HIC 83921 is a short period pulsating star with a range about 0.08 magnitudes in the V band.

In order to draw some astrophysical considerations, we must take into account the pulsation period of HIC 83921 as well as its spectral type and its range. The period found during the present investigation is 0.126 days that coupled with the spectral type F0; the shape of the light curve enabled us to classify this star as a probable Delta Scuti. HIC 83921 seems to match well the typical parameters of this class of pulsating stars.

Further photoelectric observations are planned for the future.

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PHOTOMETRY OF STARS IN THE FIELD OF V431 ORIONIS

V431 Orionis (= BD+11°755) is a cool carbon star that varies over a range of about two magnitudes, becoming as bright as visual mag. 9. The variability was discovered by Morgenroth (1933), who suggested it was a Mira variable. In contrast, observations by Olivier (1959) showed the variations to have a period of only 122 days. He suggested, however, that this period is approximate only, and that the variations may be irregular. I observed a number of stars in the field as a check on the existing AAVSO comparison sequence, which is based on Olivier's.

The position of the variable given by Morgenroth is slightly in error. The star does not appear in astrometric catalogues, but more accurate positions can be found in the IRAS catalogue and in the Guide Star Catalogue; the GSC position is listed in Table 2 below.
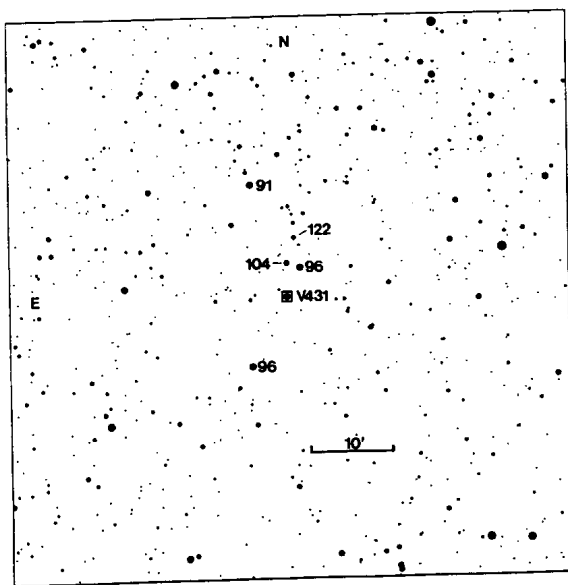
Figure 1. The field of V431 Orionis showing stars from the GSC. V magnitudes are indicated to the nearest tenth with the decimal point omitted.

Table 1. Standard Star Observations

Name	V	$b-y$	V	$b-y$	n	source
	(std)		(obs)			
HD 11577	7.707	0.112	7.710	0.108	1	O83
HD 16802	7.236	0.701	7.235	(0.720)	1	O83
HD 23324⋆	5.665	−0.022	5.665	−0.017	1	O83/CB70
HD 24357⋆	5.970	0.221	5.973	0.225	1	Nic/CB70
HD 24482	8.184	1.256	(8.208)	1.267	3	Lowell
HD 26546	6.085	0.658	6.089	0.660	1	Lowell
HD 27749⋆	5.632	0.179	5.638	0.180	1	POC/CB70
HD 33021⋆	6.165	0.397	6.172	0.398	3	POC/O83
HD 35299	5.701	−0.092	5.715	−0.098	1	GO76
HD 41143	7.757	0.720	7.763	0.732	1	GO91
HD 42131	7.059	0.614	7.061	0.620	1	GO91
HD 42049	5.929	1.044	(5.951)	1.057	1	HO87/Lowell
HD 42398	5.821	0.683	5.815	0.686	1	Lowell
HD 42824	6.627	0.019	6.621	0.029	2	GO76/C72
HD 43358⋆	6.363	0.296	6.368	0.298	1	POC/O83
HD 44974	6.524	0.571	6.524	0.570	1	Lowell
HD 48805	6.497	0.543	6.497	(0.528)	1	O93
HD 52533	7.702	0.006	7.693	0.000	1	L83/Lowell
HD 57006⋆	5.915	0.339	5.914	0.333	1	GOS/O83
HD 58580	6.781	−0.003	6.780	−0.008	1	O83
HD 60803⋆	5.902	0.376	5.902	0.378	2	O83
HD 73665	6.391	0.603	6.386	0.598	3	O93/CB69
HD 73666	6.619	0.005	6.609	0.005	2	†/CB69
HD 74721	8.715	0.029	8.713	0.026	2	AT91/S91
HD 79248	6.480	0.017	6.490	0.017	1	Nic/C72
HD 85217⋆	6.236	0.305	6.234	0.307	1	GOS/O83
HD 86238	7.272	0.815	7.268	(0.803)	1	Lowell

†V is weighted mean of Sowell & Wilson (1993) and S91.

I observed the variable and comparison stars using the Lowell 53cm telescope on 30 January and 1 March 1994 UT. Strömgren y and b filters were used through a 29-arcsec diaphragm. Each observation consisted of at least three 10s integrations on 'star' and two 10s integrations on 'sky', with more integrations for stars fainter than about mag. 9.0.

The values for the primary and secondary standard stars were taken mostly from the work of E. H. Olsen, supplemented by the sources listed in Table 1. Dr. Olsen has supplied revised values for the primary four-color standards (marked with ⋆ by the star name) derived from the original standard-star list of Crawford & Barnes (1970). The "Lowell" secondary standards were observed on about thirty nights each over several seasons with the 53cm telescope directly against primary standards. Table 1 shows the adopted and observed mean V and $b-y$, the number of observations 'n', and the source for the standard values. The stars are sorted in RA order for equinox 2000. The data in parentheses were omitted from the transformations, mostly involving the slightly variable

Table 2. Photometry of Stars in the Field of V431 Orionis

Name	RA (2000) Dec		V	$b-y$	n	spec	Remarks
V431 Ori	$5^h15^m57\overset{s}{.}7$	$+11°58'40''$	10.595	4.317		C5,5	(1)
			10.536	4.415			(2)
HD 34203	5 16 04.1	+11 20 29	5.535	-0.002	2	A0V	(3)
			.004	.001			
HD242171	5 16 15.4	+12 12 12	9.080	0.314	2	G0	
			.002	.004			
HD242111	5 15 51.3	+12 02 08	9.565	0.312	3	A0	(4)
			.005	.008			
BD+11°758	5 16 15.1	+11 50 18	9.619	1.414	2		(5)
			.004	.008			
HD242126	5 15 57.7	+12 02 42	10.391	0.341	2	F8	(6)
			.006	.016			
GSC 0707-1121	5 15 54.0	+12 05 43	12.233	1.176	1		
			(.024)	(.037)			

Remarks:

(1) - = BD+11°755. observation on 30 Jan 1994 UT.

(2) - observation on 1 Mar 1994 UT.

(3) - = HR 1718 = 18 Ori. V = 5.56 (Oja 1983), $b-y$ = -0.004 (Crawford et al. 1972).

(4) - = GSC 0707-1127.

(5) - = IRAS 05134+1137 = GSC 0707-1711.

(6) - = GSC 0707-1121.

red stars, which are not primary standards. The mean deviations of the observed averages from the assumed values in this group of data are: V = +0.001 ± 0.006; $b-y$ = +0.002 ± 0.006.

Results for the stars near V431 Orionis are shown in Table 2, sorted in order of decreasing brightness. The individual observations of V431 Ori are given in the first entry. The stars are identified by HD, BD, or GSC number; positions come from the PPM and Carlsberg Meridian Circle astrometric catalogues or the GSC; spectral types were retrieved from the literature via SIMBAD. The standard deviations of the mean values are given in the second line of each entry. For the single measure of the faintest star, the uncertainties (in parentheses) are merely the internal *rms* errors on the batches of integrations and the errors in the fit to the standards taken in quadrature.

The color of V431 Orionis is extremely far outside the range of the standards. The results are thus subject to both 'reduction errors' from extrapolating the calibrations defined by the standards, and especially 'conformity errors' from the mismatch of the carbon star spectrum to the ordinary stars comprising the standards (*cf.* Manfroid & Sterken 1992). Much of the scatter in $b-y$ between the two observations arises simply from photon-statistical errors in b, since the star is nearly mag. 15 in that filter. On the other hand, we are extrapolating the system *three magnitudes* beyond the reddest standard!

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For the convenience of observers, a chart derived from the GSC is shown in Figure 1. The comparison stars are indicated by their V magnitudes rounded to the nearest tenth (decimal point omitted) in the style of visual variable-star charts.

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PHOTOMETRY OF THE ACTIVE STARS HD 127535 AND HD 202077

In this paper we present new photometry for the two southern active late-type stars HD 127535 and HD 202077 from June to July 1994.

HD 127535 = V841 Cen ($\alpha = 14^h34^m16^s$, $\delta = -60°24'27"$, 2000.0, $V = 8.5$ mag) is a rapidly rotating, single-lined spectroscopic binary with an active K1 subgiant as the primary component (Collier et al. 1982). The star exhibits strong Ca II H&K and Hα emission (Houk & Cowley 1975, Weiler & Stencel 1979, Collier et al. 1982), it shows high X-ray flux in the ROSAT 0.1-2.4 keV energy range (Dempsey et al. 1993) and also very high radio-flux densities (Slee & Stewart 1989). The orbital period is 5.998 days with zero eccentricity (Collier 1982a) while the photometric (= rotational) period of the K1 subgiant is 5.929±0.024 days (Cutispoto 1990). Thus, the orbital motion and the stellar rotation are bound but not quite exactly synchronous. Previous photometry of HD 127535 was presented by Collier (1982b) from 1980–81, by Innis et al. (1985) from 1981, by Udalski & Geyer (1984) from 1984, by Bopp et al. (1986) from 1985, by Mekkaden & Geyer (1988) from April 1987 and Cutispoto (1990) from February 1987, and most recently by Cutispoto (1993) from 1989. Randich et al. (1993) determined the Lithium abundance and the $v \sin i$. HD 127535 is listed as star number 118 in the "Catalog of Chromospherically Active Binary Stars" (Strassmeier et al. 1993).

HD 202077 = BM Mic ($\alpha = 21^h14^m31^s$, $\delta = -30°45'24"$, 2000.0, $V = 8.3$ mag) is an apparently single G6 IV/V star (Houk 1982) with Ca II H&K in emission (Lloyd-Evans & Koen 1987). Extensive photometry was presented by Lloyd-Evans & Koen (1987) for the observing period 1979–1981 who also determined the photometric period of HD 202077 of 14.6 days. With this period, the star showed a sinusoidal light curve with a full amplitude of 0.2 mag in Johnson V in 1979–1981. Otherwise there is nothing known about this star.

The new data in this paper were obtained on 15 nights at the 70-cm Swiss-telescope at ESO La Silla in Chile between June 24th and July 15th, 1994. All seven Geneva-colours were measured almost simultaneously. For a description of the Geneva-system see Rufener & Nicolet (1988). The observers were P. North and E. Paunzen. For the reduction we used the Geneva [U], [B] and [V] filters which are similiar to Johnson U, B and V (for relations see Cramer 1984). Every light-curve point for the two stars is the average of ten individual 60 sec measures taken within 10 minutes. The data were corrected for sky background and extinction. Tables 1 and 2 list the differential [V], [U − B], and [B − V] magnitudes for HD 127535 and HD 202077, respectively. Their respective comparison stars were HD 128227 ($V = 8.350$ mag; e.g. Collier-Cameron 1987) and HD 202540 ($V = 6.851$ mag, Lloyd-Evans et al. 1983).
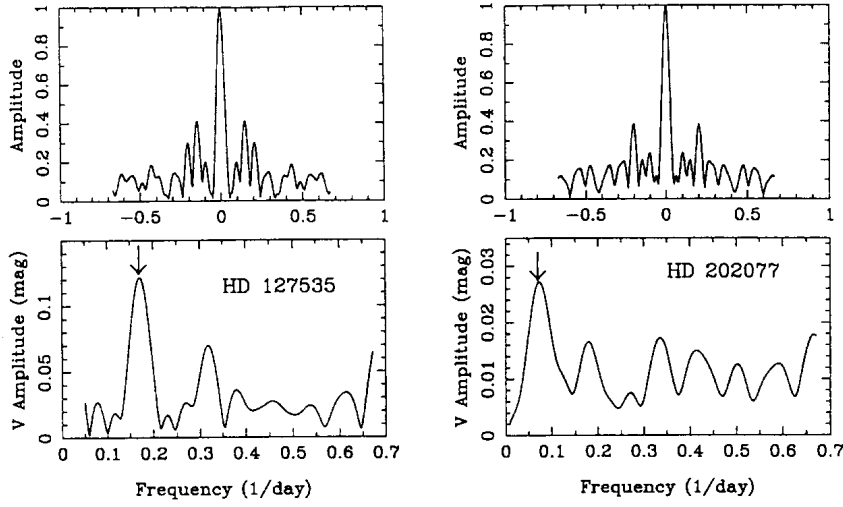
Figure 1: Periodograms from the [V] data of HD 127535 (left panels) and HD 202077 (right panels). The upper graph shows the window function and the lower graph is the periodogram for the two stars, respectively. The "best" periods are indicated and are 5.86 days for HD 127535 and 14.3 days for HD 202077.
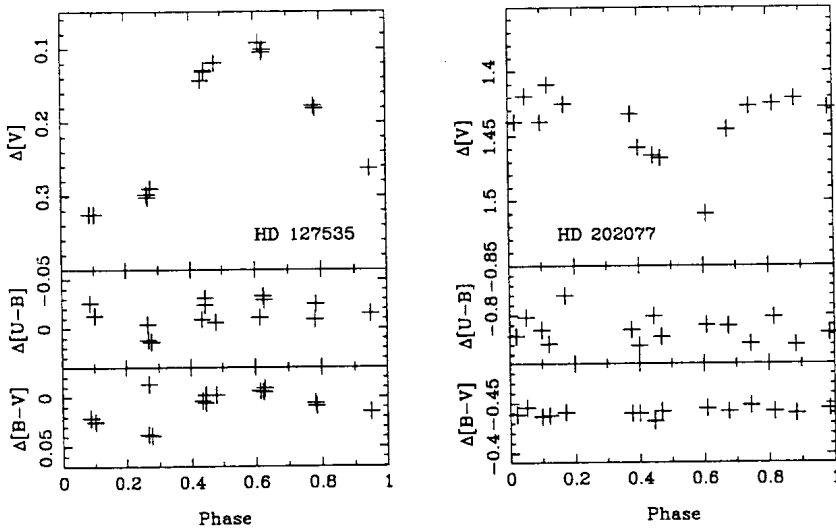

Figure 2: [UBV] light and color curves for HD 127535 (left panels) and HD 202077 (right panels). The HD 127535 data are plotted with the ephemeris JD 2,445,804.1+5.929×E and for HD 202077 with JD 2,449,000.0+14.3×E.

Table 1: Geneva [UBV] photometry of HD 127535 and HD 202077

HD 127535–HD 128227				HD 202077–HD 202540			
HJD 244+	$\Delta[V]$ (mag)	$\Delta[U-B]$ (mag)	$\Delta[B-V]$ (mag)	HJD 244+	$\Delta[V]$ (mag)	$\Delta[U-B]$ (mag)	$\Delta[B-V]$ (mag)
9528.0285	0.325	−0.026	+0.021	9528.3764	1.428	−0.782	−0.445
9529.1118	0.302	+0.012	−0.013	9529.3403	1.419	−0.798	−0.446
9530.0944	0.143	−0.009	+0.004	9530.3319	1.410	−0.771	−0.438
9534.0465	0.325	−0.013	+0.025	9534.3174	1.459	−0.769	−0.440
9535.0250	0.298	−0.004	+0.038	9535.3056	1.467	−0.778	−0.442
9536.0847	0.131	−0.031	−0.002	9537.3167	1.510	−0.790	−0.445
9537.1632	0.101	−0.029	−0.009	9538.2792	1.445	−0.789	−0.442
9538.0736	0.177	−0.009	+0.006	9539.2486	1.427	−0.771	−0.448
9539.0701	0.263	−0.015	+0.015	9540.2799	1.425	−0.798	−0.442
9541.0208	0.290	+0.014	+0.039	9541.2361	1.421	−0.770	−0.440
9542.0132	0.129	−0.024	+0.006	9543.1917	1.439	−0.779	−0.439
9543.0146	0.092	−0.011	−0.006	9544.3264	1.439	−0.785	−0.437
9544.0215	0.181	−0.025	+0.009	9545.3458	1.425	−0.820	−0.441
9548.1410	0.119	−0.006	−0.002	9548.2847	1.433	−0.785	−0.440
9549.0028	0.105	−0.033	−0.005	9549.2708	1.465	−0.799	−0.432

Our data were examined for periodicity with a standard period-finding program, and we obtained the greatest reduction of the sum of the squares of the residuals at a period of 5.86±0.10 days for HD 127535 and 14.3±0.5 days for HD 202077, in agreement with previous determinations. Figure 1 shows periodograms for both stars and their respective window functions. The full amplitudes in $[V]$, $[U-B]$ and $[B-V]$ are 0.23±0.02, 0.035±0.010, and 0.050±0.007 mag, respectively for HD 127535 and 0.060±0.015, ≤0.05, and ≤0.015 mag, respectively for HD 202077. The light and color curves are plotted in Fig. 2 versus rotational phase (data were phased with the photometric periods cited in the caption of Fig. 2).

As compared to earlier observations, HD 202077 seems to be in a low-amplitude state in mid 1994, while the light curve amplitude of HD 127535 is at the previously observed maximum of 0.25 mag from 1984 (Udalski & Geyer 1984).

If we assume that the photometric period of HD 127535 is the rotation period, the $v \sin i$ measure of 33±2(?) km s^{-1} (Randich et al. 1993) leads to a minimum radius of 3.8±0.3 R$_\odot$. Several sources quote a typical radius of ≈0.8 R$_\odot$ for a K1 dwarf, and ≈17 R$_\odot$ for a K1 class III giant. Thus, our radius determination is consistent with a slightly evolved star. No $v \sin i$ measure is available for HD 202077.

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A DIRECTORY OF COMPARISON STARS IN IBVS

In many issues of IBVS observers have published their observations of particular variables, obtained by differential photometry in the UBV system. Usually they have specified the comparison and check stars used, and often give UBV values. Whilst all variables (including new and suspected ones) reported in these pages are properly listed in the normal Index to IBVS, it is beyond the scope of the Index to record ancillary information, such as comparison stars used.

Several years ago I wished to determine quickly which stars have been employed as comparison stars, and have also been measured in the UBV system. I compiled a Directory of Comparison Stars Cited in IBVS, commencing with IBVS No. 2081, the earliest one in my set. The Directory concentrates on fainter comparison stars, for which the IBVS data is likely to be new. Stars brighter than 6.0V are generally omitted, as these stars all appear in the Bright Star Catalogue. Some basic facts on the Directory are as follows: Number of records: 520. IBVS numbers searched: 2081-4039. V and B−V values are included, as are standard catalogue ids. Positions, for 1950, are given for all stars. Additional notes are given for about 50 stars. A number of misprints and cases of inconsistent data are noted. The Directory does not purport to give complete data for each entry, but rather, it guides the user to the original IBVS paper, where additional data will usually be found.

The Directory is available from the writer, as a hardcopy printout, or as IBM PC readable files (Lotus 1-2-3 and ASCII text file formats). Interested persons may obtain a copy at no cost by sending any recent reprints containing UBV photometric data. Otherwise, the Directory is available by sending US$10 to cover postage and handling costs.

A second directory (the "Miscellaneous List") will also be sent. This file (about 380 records) lists in the same fashion comparison stars taken from a variety of other serials and publications.

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DETECTION OF VARIABILITY IN HD 168947

We obtained two nights of differential photometry of HD 168947. The observations were done at the 70 cm Swiss-telescope at ESO, La Silla. The observers were P. North and E. Paunzen. The measurements are in the Geneva photometric system (Rufener and Nicolet, 1988) and the integration time was 3 minutes. In one night (30.06./01.07.) we observed one comparison star (C1, HD 168287, m_V=7.3, A3m), in the second night (10.07./11.07.) we observed an additional comparison star (C2, HD 170149, m_V=7.6, F5IV). Both comparison stars proved to be constant within an upper limit of 0.003 mag in Geneva-V.

HD 168947 is a binary star with a B type companion in a distance of 5.5 arcminutes (Eggen, 1982). Eggen gives a spectral type of A3 II/III. The following calibrations have been adopted by Strömgren indices (Moon & Dworetsky, 1985):

$$T_{eff} = 7500 \, K, \; log \, g = 3.6, \; \delta m_0 = 0.064$$

Because of the decreased metallicity and the classification as luminosity-class II/III star, HD 168947 is a candidate for the λ Bootis group (Gray, 1991) which contains metal weak A type stars with broad and shallow hydrogen lines. The properties of this group are described in Weiss et al. (1994). The spectrum of HD 168947 shows a weak λ 4481 Mg II line, but otherwise the characteristics are normal for early A type stars (Gray, 1994). Further observations have to prove the membership to the λ Bootis group.

The evolutionary status of this group is not clear. In one scenario these stars are at the end of the ZAMS, in another they are just arriving at the ZAMS. In the first case diffusion would be the mechanism determining the peculiar abundance pattern, in the other it would be accretion and/or mass-loss. It is interesting that Eggen suggested that this star has *not* yet arrived at the ZAMS.
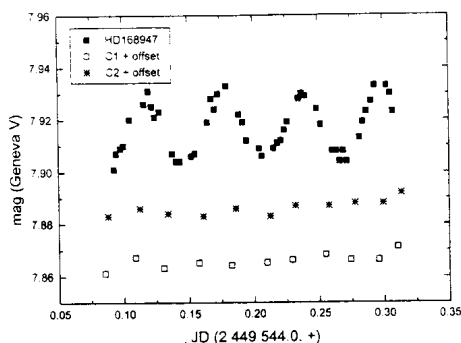
Figure 1. The light curve for HD 168947, C1 and C2 for the second night in Geneva-V
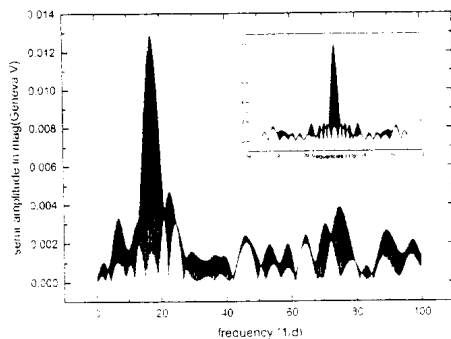
Figure 2. Amplitude spectrum for the differential data
of HD 168947 and HD 168287, the spectral window is inserted

With the tools of asteroseismology it should be possible to derive the evolutionary status of stars. We started therefore a survey for pulsation among λ Bootis stars. Up to now we found 6 new pulsating stars. For HD 168947 we observed a period of 17.2 c/d (84 minutes) and an amplitude of about 0.026 mag in Geneva-V (see Figure 2). This period is consistent with an expected period of an A type star arriving at the ZAMS (Stellingwerf, 1979). Figure 1 shows the light curve for the second night for all three measured stars.

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Stellingwerf, R., 1979, *ApJ*, **227**, 935
Weiss, W.W., Paunzen, E., Kuschnig, R., Schneider, H., 1994, *A&A*, **281**, 797

DISCOVERY OF PULSATION IN THE λ Boo STAR HD 111786

The group of λ Bootis stars consists of early A type population I objects which are metal poor and their $v \cdot \sin i$ values exceed on average 100 km/s. HD 111786 (m_V=6.15, HR 4881, BD−26°9369) was classified by Gray and Corbally (1993) as A1.5 Va λ Boo .

Our photometry was obtained using the 'modular photometer' attached to the 0.5m telescope of the South African Astronomical Observatory (SAAO) in Sutherland and was scheduled from April 20, to May 10, 1994. The measurements are 10 second integrations with a Strömgren v filter. A 30 arcsec diaphragm was used throughout. As primary comparison star we used
HD 111295 (C1, m_V=5.7, HR 4860, BD−26°9340, G5III-IV), and during the last two nights as an additional comparison star
HD 111226 (C2, m_V=6.4, HR 4857, BD−26°10540, B8III).

HD 111786 was found to be variable already in the first night (May 3/4, 1994) and monitored during the following seven nights. A full observing log is given in Table 1. The observations from the night of May 8/9 were excluded from our present analysis, because of strong sky transparency variations and hence poor quality of the data.

Table 1: Observing log.

night	hours		data points	
May '94		HD111786	HD111295	HD111226
3/4	3.62	1118	69	-
4/5	7.80	2591	57	-
5/6	7.43	2362	72	-
6/7	6.51	1916	57	-
7/8	7.28	2377	72	-
8/9	5.15	734	201	202
9/10	7.38	1550	216	211
total	45.17	12648	744	413

Figure 1 shows the light curves of the program and both comparison stars for the last night. The instrumental magnitudes are plotted relative to the night mean. The variability of HD 111786 is clearly visible and superimposed on low frequency transparency changes, which are evident also in the light curves of both comparison stars.

In a next step, long term trends were removed from the data sets of each night and a Fourier analysis was computed. The amplitude spectra and the spectral window from the merged data are shown in Fig. 2. The maximum peak in the frequency spectrum appears at f=31.02 d^{-1} (46.42 min) with a semi-amplitude of 6.2 mmag. This amplitude spectrum gives evidence for the presence of more than one pulsation frequency, a presumption which is supported by the amplitude modulation of the entire light curve (Figure 3).
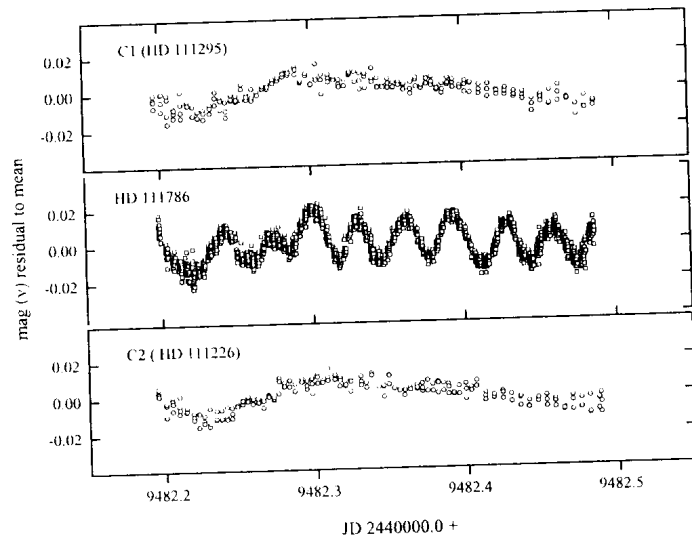
Figure 1: Instrumental Strömgren v data for HD 111786 and both comparison stars
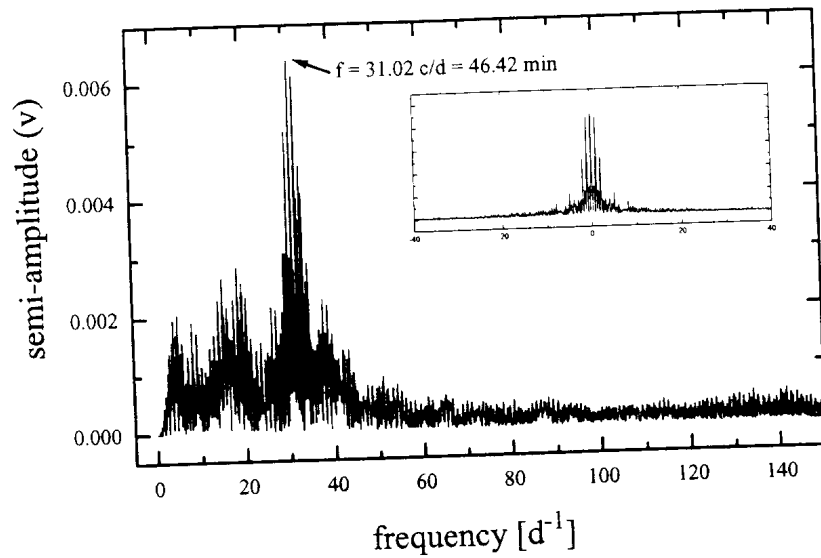
Figure 2: Amplitude spectra (v) for HD 111786 and the comparison star C1
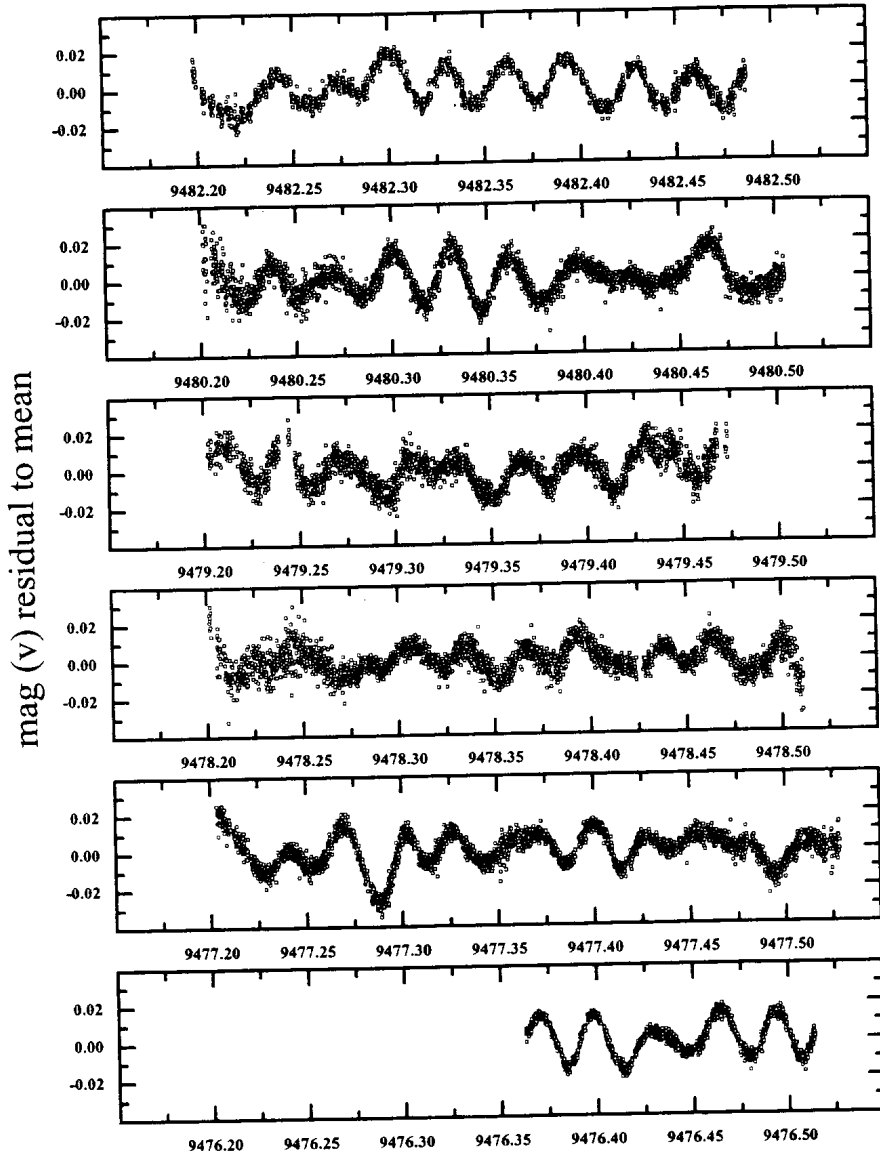
Figure 3: Light curve of HD 111786

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(46.42 min) with a semi-amplitude of 6.2 mmag. This amplitude spectrum gives evidence for the presence of more than one pulsation frequency, a presumption which is supported by the amplitude modulation of the entire light curve (Figure 3).

This object is the third one found to be variable as a result of our survey for pulsation among λ Boo stars (Paunzen & Weiss 1994, Weiss et al. 1994). The driving argument for this survey was the possibility to apply the technique of asteroseismology for determining the structure and evolutionary status of λ Boo stars. Finding multi-periodic pulsation increases significantly the potential of this method, because each new observed frequency allows a better determination of stellar model parameters.

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Paunzen E., Weiss W.W., 1994, *IBVS*, No. 3986
Weiss W.W., Paunzen E., Kuschnig R., Schneider H., 1994, *A&A*, **281**, 797

HD 183324, A PULSATING λ Boo STAR?

λ Bootis stars are a class of chemically peculiar A-type (CP2) stars. They have a typical Pop I kinematics, but their metallicity is up to a factor of 100 too low for this type of population.

HD 183324 (m_V=5.8, HR 7400, BD$-1°4010$) was selected as a candidate for a southern hemisphere survey for variability among λ Boo stars. The spectral classification by Gray and Corbally (1993) for this object is A0 Vb λ Boo. Our observations were obtained in May 1994 at SAAO with the 0.5m telescope and a single channel photometer. A Strömgren v filter, and a 10 s integration time was chosen. Two comparison stars were used:

HD 180482 (C1, m_V=5.6, HR 7303, BD$-4°4045$, A3IV), and

HD 178596 (C2, m_V=5.2, HR 7266, F0III).

More information on the observations is listed in Table 1.

Table 1: Observing log.

night May '94	hours	number of observations		
		HD183324	HD180482	HD178596
1/2	2.99	410	47	53
2/3	3.66	1073	57	56
3/4	3.76	1205	41	-
4/5	3.54	1169	25	-
5/6	1.55	478	28	-
7/8	4.13	1360	45	-
9/10	4.32	1098	94	57
total	23.95	6802	307	166

Figure 1 shows the residuals to the mean instrumental magnitudes for the night of May 9/10. The light curve of both comparison stars is basically constant, only smooth sky transparency variations are visible. The parabolic trend in the light curve of C2 comes from a slightly incorrect extinction coefficient, which is inadequate for the late spectral type of C2 (F0) – compared to C1 (A3). The measurements of HD 183324, however, give clear evidence for amplitude modulated variability.

After subtraction of long term trends caused by sky transparency variations we computed an amplitude spectrum for all merged data of the program star (Figure 2). The maximum semi-amplitude for HD 183324 with 2.08 mmag(v) appears at the frequency f=47.37 1/d (30.39min). The bulk of frequencies around this highest peak is broader than a single period would produce according to the spectral window (inset in Figure 2). This property may be taken as evidence for at least one other frequency in this λ Boo star. Furthermore, all light curves show a significant amplitude modulation in each night (Figure 3).
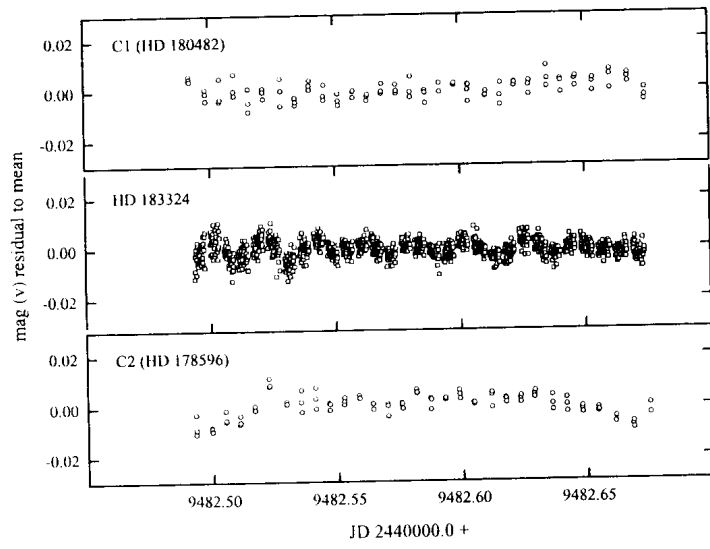
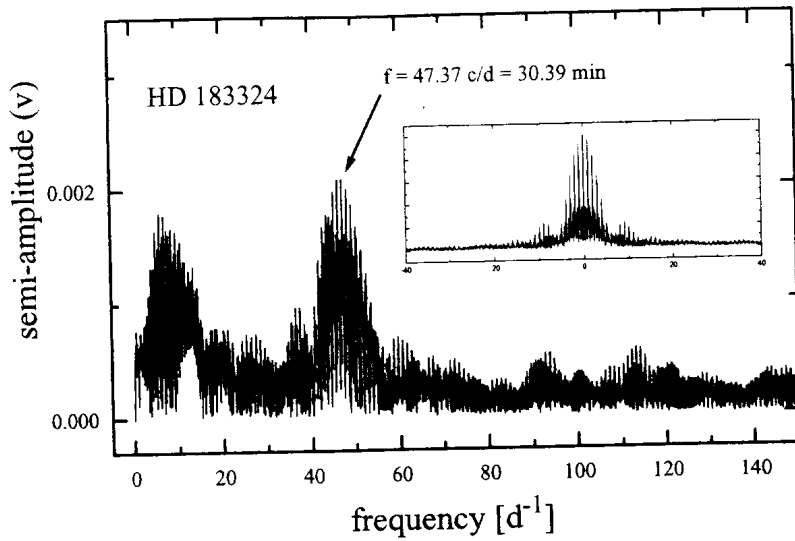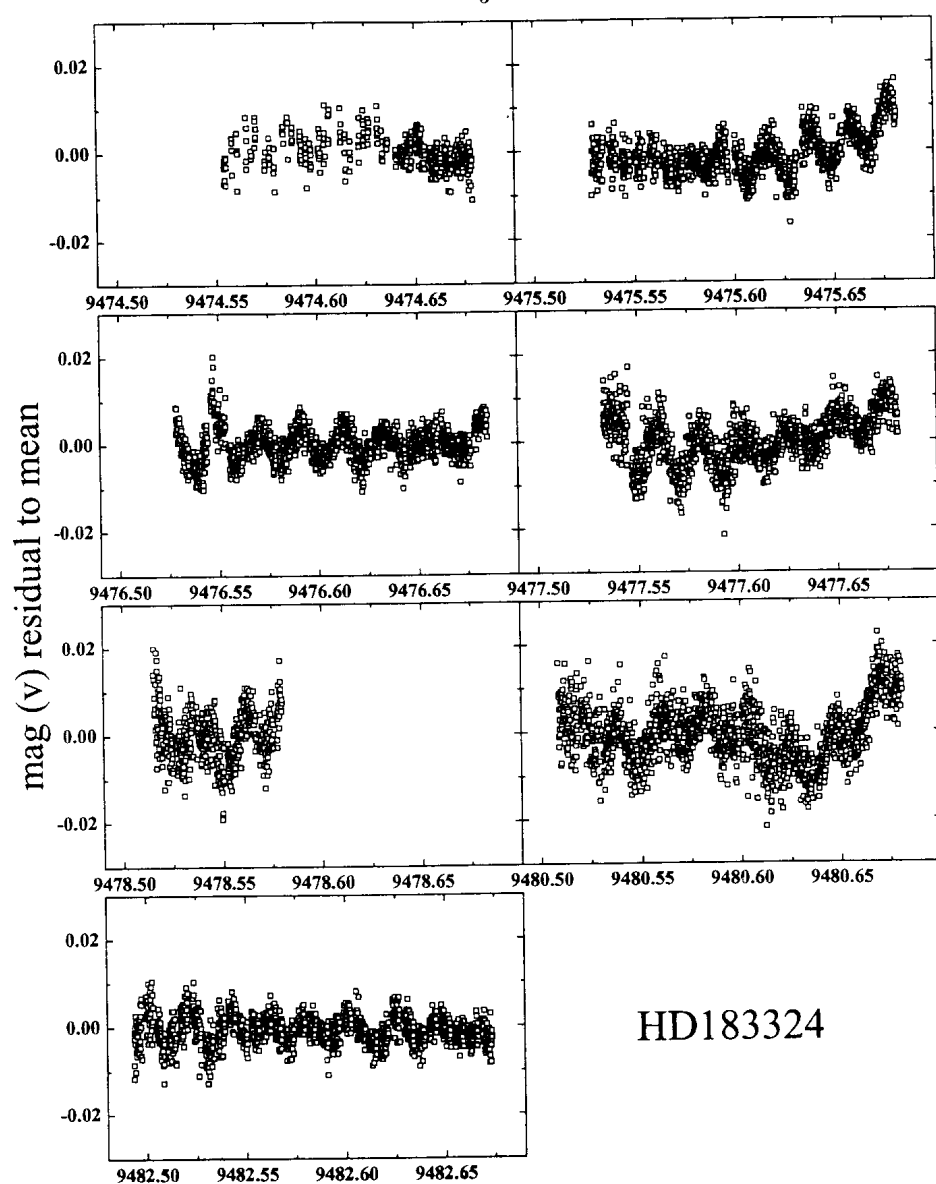Figure 1: Instrumental Strömgren v data for HD 183324 and both comparison stars

Figure 2: Amplitude spectrum (v) for HD 183324

HD183324

JD 2440000.0 +

Figure 3. Light curves of HD 183324

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Because of the period of about 30 minutes, the shortest period ever found in this group of peculiar stars, HD 183324 is an outstanding λ Boo star. Variations in this frequency domain come already close to the well known rapid oscillations in some cool Ap (roAp) stars.

Our discovery increases the number of known variables in the group of λ Boo stars to 10. It is the fourth variable we found in our survey which started at ESO in 1993. The suspected presence of multi-mode pulsation similar to δ Sct stars definitely requires the organisation of photometric multi-site observing campaigns in order to derive reliable pulsation frequency spectra (Weiss et al. 1994).

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PHOTOMETRIC PERIOD OF THE SUSPECTED
DELTA SCUTI-TYPE STAR IOTA BOOTIS

Iota Boo (= 21 Boo = NSV 06610 = HR 5350) is a suspected low-amplitude DSCTC-type variable according to Kukarkin et al. (1982) and Kholopov et al. (1985). In spite of the photometric variability reported by Albert (1980) this star was used several times as a photometric standard (e.g. Glushneva, 1992), but it was neglected as far as the study of its light changes is concerned. Albert's result was more or less confirmed by Szatmáry (1988) but no other analysis of the light curve has been published yet. We note that some references for this star given e.g. in the SIMBAD database correspond to 44i Boo, a bright W UMa-type eclipsing binary, instead of Iota Boo.

We carried out photoelectric photometry (in Johnson-system using B and V filters) of Iota Bootis on three nights: 29 June, 8 and 9 July, 1993 with the 40 and 50 cm Cassegrain telescope of Szeged Observatory and Konkoly Observatory, respectively. The comparison and check stars were Theta Boo (HR 5404) and HR 5360, respectively. There were simultaneous observations on the last night at the two observing sites located in 200 km distance from each other. The aim of this short campaign was to separate the light variation of Iota Boo from the atmospheric effects and re-check the photometric period(s) found by Albert (1980) and Szatmáry (1988). Unfortunately, the light curves obtained have only limited accuracy (0.02-0.03 mag) due to instrumental problems and weather conditions, therefore these curves are mainly dominated by observational noise. However, the multi-site observations enabled us to filter out the noise and detect a frequency component which is very probably due to rapid oscillation of Iota Boo. We used the raw (variable star minus sky) data for period analysis.

The method used for noise-filtering has been known in data processing for a long time and based on the following: if we compute Fourier spectra of different light curves of a variable star and then superimpose, the amplitude of the noise decreases relative to the amplitude of the real oscillation, because the peaks caused by the noise are not exactly at the same position in the different spectra, in contrast with the oscillation peak. In other words, we can "average out" the noise relative to the signal. It is important to note that the signal-to-noise ratio cannot be increased and the amplitude of the oscillation, of course, cannot be determined properly by this method.

The sum of the spectra is plotted in Figure 1 (based on both V and B data because the position of the oscillation peak does not depend on the wavelength). As it can be seen, there is a peak at 35.6 c/d (about 40 min period) in the summed spectrum of Iota Boo which is in good agreement with the results of previous studies. Meanwhile, the composite spectra of the comparison stars do not show peak at the given frequency interval. Therefore we conclude that Iota Boo definitely shows low-amplitude oscillation with the period mentioned above. The amplitude of the oscillation is close to the errors of our measurements, and probably does not exceed 0.05 mag. This means that the variation and the presumable type of Iota Boo (DSCTC) is also confirmed.
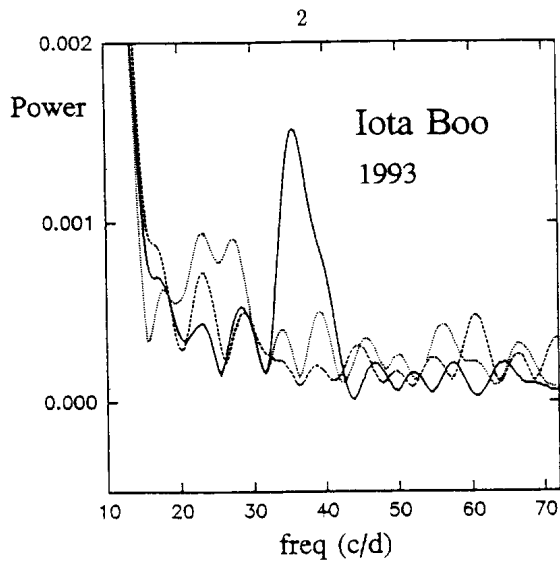
Figure 1. Sum of the spectra. The continuous line represents
the spectrum of Iota Boo, while the dashed and dotted lines
show the spectrum of comparison and check star, respectively.

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SPECTROSCOPY OF FAINT CATACLYSMIC VARIABLES I

TV Corvi (Tombaugh CV, 1217-18, Crv1, Nova Corvi 1931)

This star was originally discovered by C. Tombaugh in 1931 during his search leading to the discovery of the planet Pluto. It had laid undisturbed for 60 years until it was rediscovered by Levy et al. (1990). They showed that TV Crv has a large outburst amplitude and they also present spectra at outburst as well as minimum light photometric data. The latter showed no periodic modulations.

Figure 1 shows our unfluxed spectrum obtained for TV Crv. AAVSO data (Mattei 1993) shows no indication of an outburst for $-12/+30$ days from our observation, so we assume it was made when TV Crv was near minimum. As the data are not fluxed, we cannot comment on the nature of the slope of the continuum, however, the spectrum seems to be typical of a low mass transfer rate system. Emission lines of hydrogen and helium are seen. The apparent emission features near 5570Å and 6300Å are due to incomplete night sky line subtraction.

The featureless red continuum shows no evidence of a secondary star. The large outburst amplitude for TV Crv ($\sim$8 mags; Levy et al. 1990) suggests that this star is a tremendous outburst amplitude dwarf nova (TOAD). All confirmed TOADs known to date have measured orbital periods which are $\leq$2.5 hrs (Howell et al. 1994). Thus, it was likely, given the probable low mass transfer rate and the large outburst amplitude, that TV Crv has a $\leq$2.5 hr orbital period. Recent high-speed photometry of TV Crv during its June 1994 outburst shows superhumps with a period near 1.6 hrs (Howell et al. 1995).

AH Eridani

This star is likely to be a DQ Her system with a spin period of 42 minutes (Szkody et al. 1989) and the orbital period is still unknown. There is possible confirmation of this period in the X-ray range from ROSAT observations (Szkody et al., 1993). Szkody (1987) published a spectrum of AH Eri covering the wavelengths from 3400 to 5400Å. Her spectrum contained strong emission lines of H and He. Our spectrum, shown in Figure 2, is similar to Szkody's but has a wavelength coverage from 4000-9000Å. It also shows strong emission lines due to H and He. There are indications of additional weaker emission lines (Fe II) throughout the spectrum. The flat continuum shape from red to blue is consistent with AH Eri having little to no accretion disk. Since the Balmer decrement is flat, the optical extinction is not a likely contribution to the redness of the continuum. Despite the possible DQ Her status, HeII is not detected.
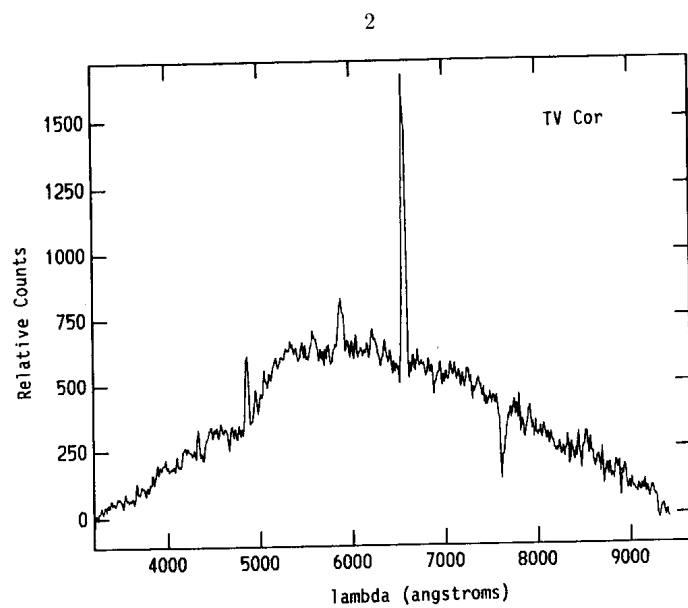
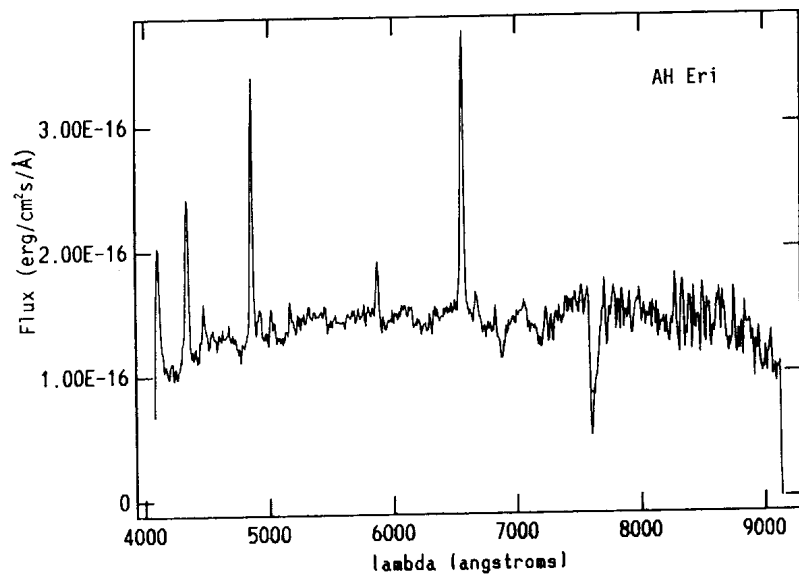Figure 1. Unfluxed spectrum of TV Crv taken with the INT on La Palma.

Figure 2. MMT spectrum of AH Eri.

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The red spectrum shows clear evidence for TiO bandheads near 5900Å, 6200Å, 6600Å, and 7000Å degrading to the red. Using K and M star templates observed during our run, we performed a χ^2 test on the difference between each template and AH Eri over the wavelength range of 5000Å to 9000Å. We found a best fit match for the TiO bands to be an M3-M5 star. This spectral type usually implies a short orbital period ($\leq$3 hrs). The data are very noisy beyond 8000Å.

Observations reported here were made at the Multiple-Mirror Telescope and at the INT on La Palma.

Table 1. Observing log

Star	UT Date	UT Start	Int. Time	Spectral Resolution	$V^{a)}$
TV Crv	1993 Mar 27	01:55	3072 sec	6Å	–
AH Eri	1992 Sep 02	10:35	1800 sec	15Å	18.5

[a] V magnitude derived from numerical filter convolutions of the spectra.

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Szkody, P., Howell, S.B., Mateo, M., and Kreidl, T.J., 1989, *PASP*, **101**, 899

SPECTROSCOPY OF FAINT CATACLYSMIC VARIABLES II

EF Pegasi

Recently, Howell et al. (1993) studied a rare outburst of EF Peg and showed that the star is a large amplitude dwarf nova with a likely orbital period of 2.05 hrs. Figure 1 shows the energy distribution of EF Peg in the visible. We note a steep blue continuum and the appearance of strong emission lines of H apparently superimposed on weak broad absorption in the higher members. He lines in emission are also present but weaker. Our MMT magnitude indicates that EF Peg was observed when $\sim$1 mag brighter than its quiescent value. If EF Peg had been observed rising to or falling from an outburst, it would explain the steep blue continuum and the weak absorption. However, AAVSO records (Mattei 1993) show no observation of an outburst for $\pm$30 days from our observation. The steeply rising blue continuum (approximately Rayleigh–Jeans) may therefore indicate a hot component in the system. Apparently EF Peg was slightly brighter in quiescence than in 1993, a situation that is known to occur in a number of dwarf novae (Howell et al. 1991). There is no indication of a secondary star seen in the spectrum.

KQ Pegasi (PG2240+193)

KQ Peg is a relatively bright object discovered in the PG survey. Green et al. (1982) found that Hα was in emission while the higher Balmer lines were in absorption. They also suggested that there may be Fe II emission in the spectrum. Szkody and Howell (1992) show a spectrum from 4400-5000Å in which Hβ and Hγ are both in absorption as well as HeI 4471. The line profiles are asymmetric with a possible cause being weak underlying emission cores.

A spectrum obtained by Ringwald (1993) shows Hα and Hβ in emission while the later Balmer lines are in absorption. His interpretation of this system is a sdB-O star, possibly with a long period orbit. Howell et al. (1991) provide a 3.5-hour-long lightcurve which is constant to within 0.05 mags, consistent with a long orbital period for KQ Peg.

An examination of our data (Fig. 2) shows that the hydrogen lines are too narrow in absorption to be attributed to a disk. The Balmer series lines in our data show a FWHM of $\sim$27Å. This is comparable to that predicted for sdB-O stars with log g=5 (FWHM $\sim$24Å; Bergeron et al. 1992), but much too narrow for a DA white dwarf of log g=8 (FWHM $\sim$80Å; Wesemael et al. 1993). The system could be a pre-cataclysmic binary, with a low mass main sequence secondary undetected in the spectrum other than by the emission line cores caused by reprocessing of the hot star flux on the facing side of the companion. This may result in sinusoidal periodic variations in the line strengths (except when viewed pole-on), but the continuum may not be varying significantly at optical wavelengths and the effect of emission lines on broad-band magnitudes may not
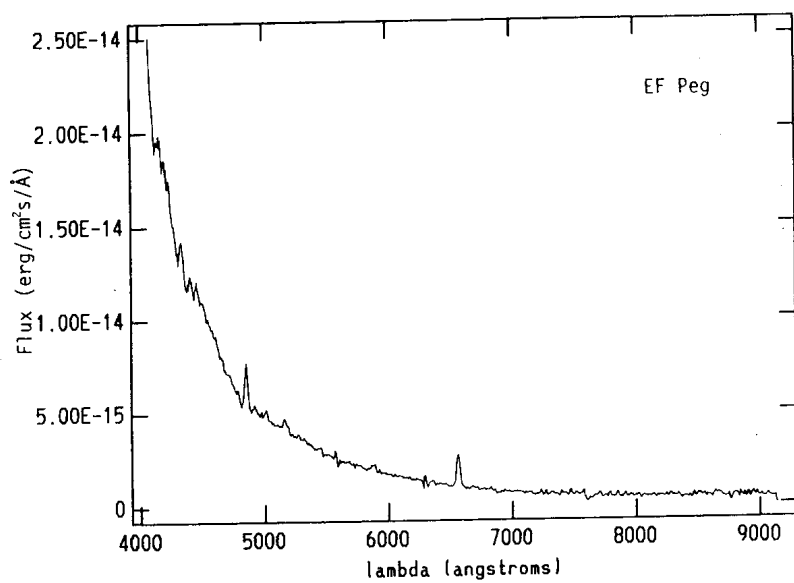
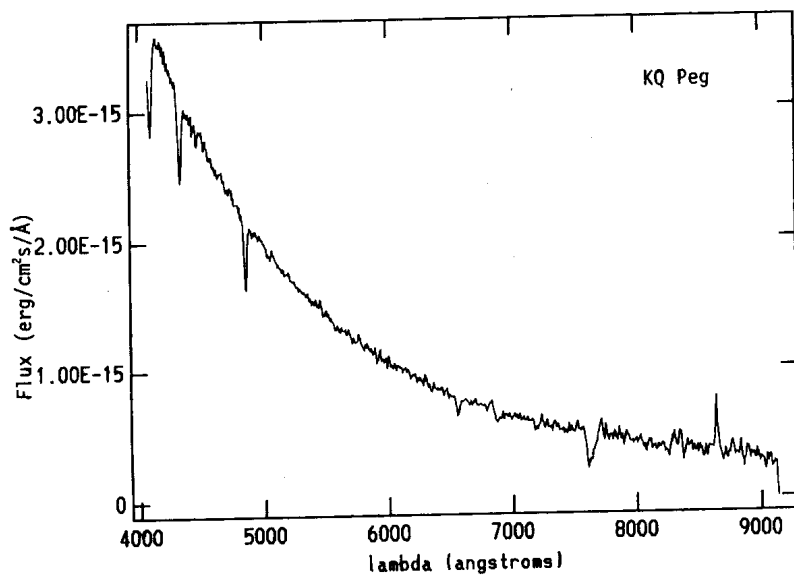Figure 1. MMT spectrum of EF Peg.

Figure 2. MMT spectrum of KQ Peg.

with a more spectacular spectrum is BE UMa (Ferguson et al. 1987). Few objects with hot subdwarf primaries are known, and the evidence for reprocessing indicates that this may be a pre-cataclysmic system with an orbital period of a few days or less.

The new data seen in Figure 2, show all the Balmer lines in absorption and the profiles appear symmetric. HeI 4471 is present in absorption as well. Apparently any emission seen in earlier data is now weak or absent, possibly due to the orbital modulation mentioned above and not some long-term change. No secondary star features are seen but weak features from a K star may be undetected at this resolution.

Observations reported here were made at the Multiple-Mirror Telescope.

Table 1. Observing log

Star	UT Date	UT Start	Int. Time	Spectral Resolution	$V^{a)}$
EF Peg	1992 Sep 02	03:19	3600 sec	15Å	17.7
KQ Peg	1992 Sep 02	06:14	600 sec	15Å	16.0

$^{a)}$ V magnitude derived from numerical filter convolutions of the spectra.

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SPECTROSCOPY OF FAINT CATACLYSMIC VARIABLES III

RU LMi (CBS 119)

RU LMi was classified as a cataclysmic variable by Wagner et al. (1987). It shows a rather odd light curve (Howell et al. 1990) and a rising blue continuum (Mukai et al. 1990). Mukai et al. obtained spectral information from 4000-9500Å while RU LMi was near its faint limit of V~19.5. Our new data presented here (Figure 1) shows strong emission lines of the Balmer series as well as fairly strong He I emission. HeII emission is also present but weaker and the Balmer jump is apparently in emission as well. High excitation lines, such as those seen in this data, can indicate the presence of a highly magnetized white dwarf, but RU LMi shows no other evidence for this interpretation. Howell et al. (1990) suggested an orbital period of near 350 minutes based on photometric observations made when RU LMi was near V~17.8. The spectrum (Fig. 1) appears typical of a dwarf nova near quiescence with the strong emission lines being indicative of a fairly low mass transfer rate. This latter fact is not what is expected for an orbital period of ~6 hrs. However, a similar case exists for AR Cnc which has an orbital period of 5.15 hrs, but shows a spectrum containing strong emission lines.

2006-17

This newly discovered CV was found serendipitously during a Palomar Schmidt plate search for asteroids (Epoch 1950 position is: $\alpha = 20^h06^m55^s$; $\delta = -17°25'27''5$ Holt, 1990). On 1990 July 27 the star was fainter than m_{pg} ~18th magnitude and on 1990 July 28 it was seen in outburst at m_{pg}~16. These are the only two observations known for that outburst so the exact level of maximum light and the outburst duration cannot be determined. Examination of the POSS plates showed no candidate, but a deep CCD image revealed a candidate star at approximately V~21.5 (Howell 1990).

Our MMT spectrum is seen in Figure 2 and shows a steeply rising blue continuum with no secondary features visible. (Due to the observation being made with the slit not at the parallactic angle and a modest telescope positional error, the extremely steep blue continuum rise is not real.) The H lines are moderately strong in emission as well as some of the prominent He lines. There are indications of other possible emission lines but the spectrum has too low a S/N to be certain. Our magnitude estimate (Table 1) shows that our MMT observation of 2006-17 was apparently obtained while rising to or falling from an outburst. Thus, we have likely confirmed a second confirmed outburst for 2006-17.

Observations presented here were made at the Multiple-Mirror Telescope and at Steward Observatory.
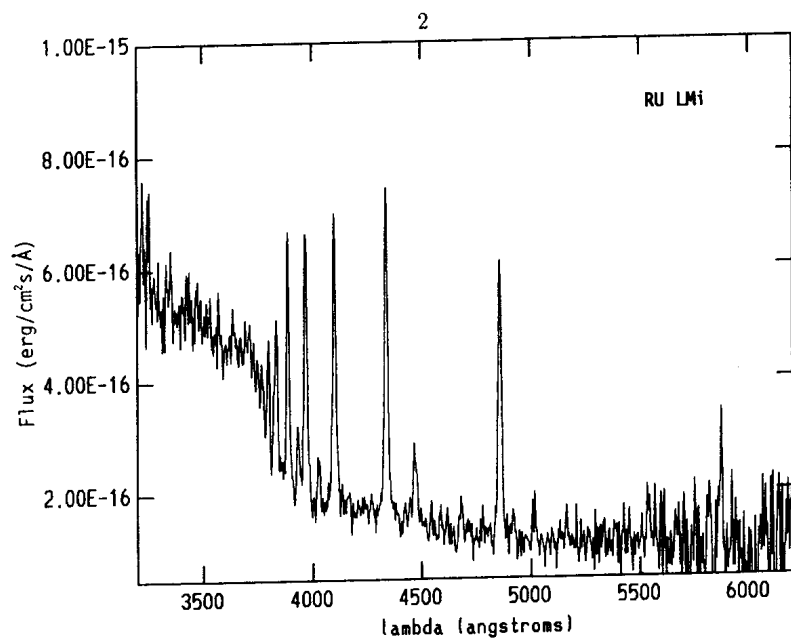
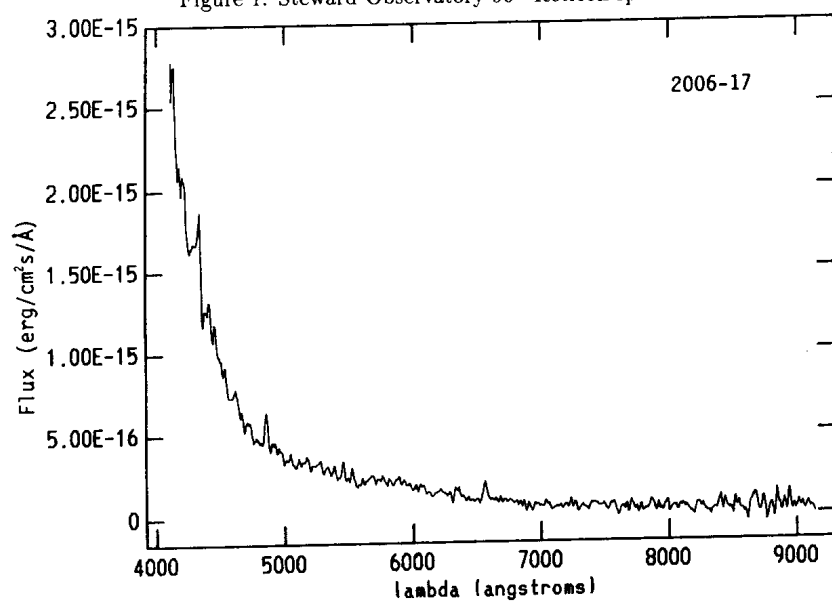Figure 1. Steward Observatory 90" Reticon spectrum.

Figure 2. MMT spectrum of 2006-17.

Table 1. Observing log

Star	UT Date	UT Start	Int. Time	Spectral Resolution	V[a]
RU LMi	1986 Jan 20	09:55	1200 sec	–	18.0
2006-17	1992 Sep 02	04:41	1800 sec	15Å	18.3

[a] V magnitude derived from numerical filter convolutions of the spectra.

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A NEW EPHEMERIS FOR UZ For

UZ For (EXO 033319-2554.2) is a member of the AM Her class of close binaries (c.f. Cropper 1990) and shows a narrow eclipse caused by the secondary star occulting the white dwarf (Beuermann, Thomas & Schwope 1988, Allen et al., 1989). This eclipse was observed on 5 separate occasions using the ROSAT X-ray satellite (0.1-2.0 keV). The eclipse ingress and egress is very rapid, taking ≤10 secs in X-rays (similar to that in the blue part of the optical spectrum; Bailey & Cropper, 1991).

The results of Allen et al. (1989) and Bailey & Cropper (1991) suggest that recent eclipse timings are not well described by a linear ephemeris, with residuals in excess of ϕ=0.006. Bailey & Cropper suggest a quadratic fit may improve the residuals. The eclipse timing of Allen et al. is not in good agreement with the other data. This is due to a typographical error in their paper (Allen, private communication). The true timing of the eclipse center in the data of Allen et al. is HJD=2447437.91927.

The new data obtained using ROSAT provide an oppurtinity to improve the ephemeris. Table 1 shows the eclipse timings used in the analysis[1]. A linear and quadratic fit were made to the data, the results of which are shown in Table 2. These show that the new linear function is a much better fit to the data than the linear ephemeris of Allen et al. (1989). Further, an F-test shows the quadratic fit is better than the new linear fit at the 97.7% confidence level. The residuals for the linear and quadratic fit are shown in Figure 1. Although the quadratic ephemeris gives a significantly better overall fit compared with the linear function, improving the fit to the first data point, it actually increases the residuals to the data obtained from the ROSAT timings.
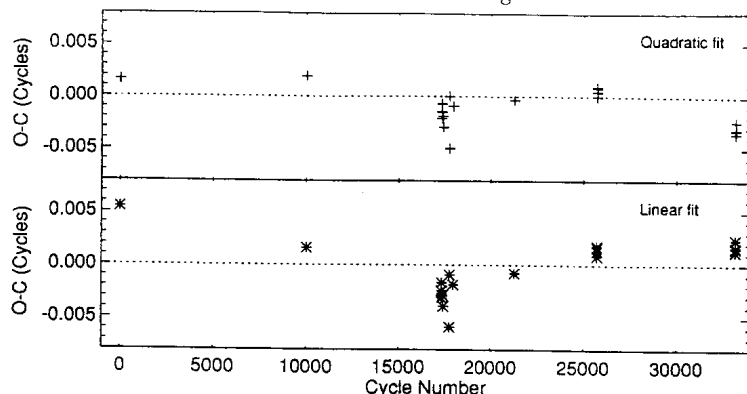

Figure 1. UZ For: the residuals to the linear and quadratic ephemerides.

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[1] The eclipse timing of 7132.936(1) (Ferrario et al., 1989) is not used due to its large error.

Table 1. UZ For: the eclipse timings used in the ephemeris
determination. The error in the last digit is shown in brackets.

HJD+2440000.0	Reference
5567.17697(16)	Osborne et al. (1988)
6446.97317(16)	"
7088.74191(30)	Beuermann, Thomas & Schwope (1988)
7089.70837(30)	"
7090.58715(12)	"
7091.55360(23)	"
7094.71672(23)	"
7097.79192(25)	"
7127.13880(30)	Ferrario et al. (1989)
7127.22710(30)	"
7145.06370(6)	"
7437.91927(3)	Allen (private comm)
7827.95413(6)	Bailey & Cropper (1991)
7828.04199(6)	"
7828.12987(6)	"
7829.00844(6)	"
7829.09635(6)	"
7829.18421(6)	"
8482.72727(20)	This work
8482.90310(20)	"
8483.34236(20)	"
8483.43023(20)	"
8483.60595(20)	"

Table 2. UZ For: the periods determined from a linear and quadratic
fit along with the period of Allen et al. (1989) for comparison.

Fit	Ephemeris	χ^2_ν
Linear	2445567.17649(14) + 0.087865429(6)E	3.07
Quadratic	2445567.17683(15) + 0.087865375(13)E + 1.7(3) $\times 10^{-12} E^2$	1.23
Allen et al. (1989)	2445567.17622(13) + 0.087865458(7)E	25.6

3

If the quadratic term is significant, then it implies that the orbital period of the system is increasing on a timescale of $P/\dot{P}=\sim1\times10^8$ years. Secular changes in the orbital period of CV's have been seen in a number of other systems (Pringle 1975, Bond & Freeth, 1988 and Warner, 1988). These have shown a decreasing orbital period on a timescale of similar magnitude (but opposite sign) to that implied for UZ For in this study. Warner (1988) attributes cyclic changes in the orbital period seen in these CVs to the solar-type magnetic cycle in the secondary star. It is more difficult to account for an apparent increase in the spin period of UZ For. The ephemeris of UZ For needs to be monitored further to determine the shape of the period variation more securely.

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Osborne, J. P., Giommi, P., Angelini, P. L., Tagliaferri, G. & Stella, L., 1988, *ApJ*, **328**, L45
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NEW LIGHT CURVES AND PERIOD
OF BV ERIDANI

The eclipsing binary system BV Eri was discovered by Hoffmeister (1933). In 1954 Solov'yov published two minimum times of BV Eri. The system was observed photometrically by Baade and Duerbeck (1979) in 1976 and 1977, in 1983 they reported an analysis of the spectroscopic orbit and the light curves.

The present work was carried out with a single channel photoelectric photometer attached to 35 cm reflecting telescope in BV bands at Yunnan Observatory from October to December 1984. The star SAO 149195 and SAO 149230 was used as the comparison and check star, respectively. From our observations we obtained 598 points in B band and 596 points in V band, in the meantime two primary minimum times and secondary a secondary minimum time was derived, which are listed in the following Table. All observational data have been corrected for atmospheric extinction and reduced to the standard UBV system. The light curves are displayed in Figures 1 and 2.

We have collected all minimum times that we could find and calculated new light elements by means of the least-squares method:

$$\text{Min.I} = \text{JD(Hel.)} 2443449.7320 + 0^d.5076669 \times E$$
$$\pm 66 \qquad \pm 10$$

Table 1

| JD(Hel.)	E	(O−C)	Weight	Source
2431052.2700	−24420.5	0.0174	1	Solov'yov
2431180.4900	−24168	0.0515	1	Solov'yov
2439059.4653	−8648	0.0366	1	Bamberg
2439767.5632	−7253	−0.0608	1	Bamberg
2440592.1167	−5629	0.0416	1	Bamberg
2441619.0528	−3606	−0.0324	1	Bamberg
2441620.0431	−3604	−0.0574	1	Bamberg
2442011.9910	−2832	−0.0284	1	Bamberg
2442013.9826	−2828	−0.0674	1	Bamberg
2443449.7207	0	−0.0113	10	Baade et al.
2444892.4762	2842	−0.0451	1	Baade et al.
2446032.2424	5087	0.0089	10	This paper
2446034.2726	5091	0.0084	10	This paper
2446048.2335	5118.5	0.0085	10	This paper
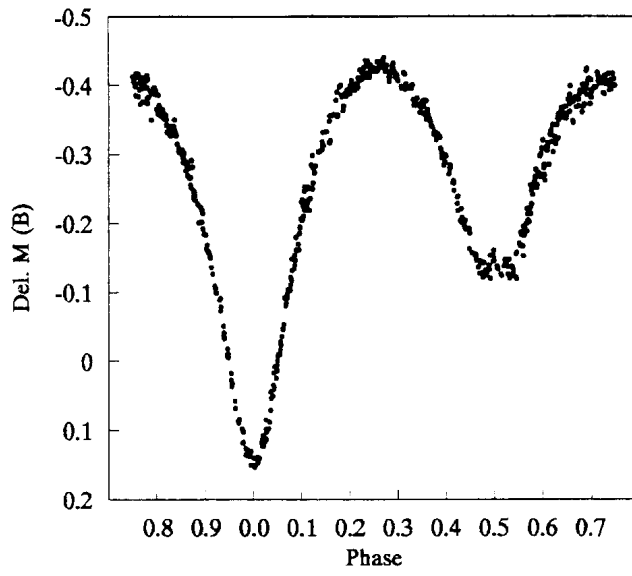
Figure 1. The light curve of BV Eri in B band.
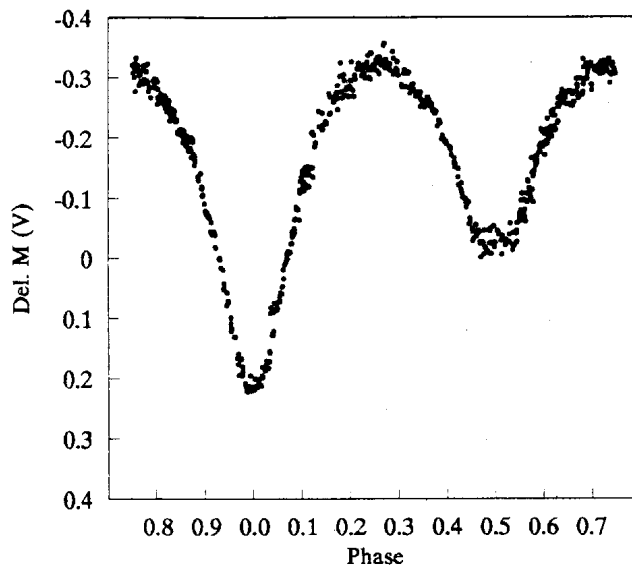
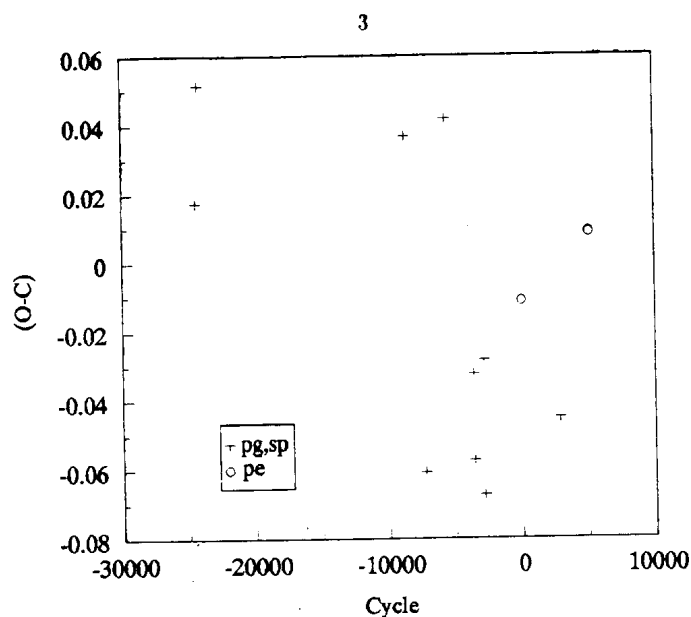Figure 2. The light curve of BV Eri in V band.

Figure 3. The O−C diagram

In calculation we assigned weight 1 to the photographic and spectroscopic minimum times, weight 10 to the photoelectric minimum times (see Table 1). Using the O−C residuals listed in Table 1 we plotted the O−C diagram (Figure 3) in which the symbol "+" means the photographic and spectroscopic minimum times and the symbol "o" means the photoelectric minimum times. In this O−C diagram the scatter is very high and no systematic trend appears. The light curve analysis using Wilson-Devinney synthesis method will be published elsewhere.

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PERIOD CHANGE OF δ Sct STAR HD 79889

HD 79889 was first reported as a variable star by Oja (1986). Some astronomers calculated its period: $0^d0958697$ (Oja, 1987), $0^d095869448$ (Rodriguez et al., 1990), $0^d095869483$ (Wunder et al., 1992). Liu et al. (1991) studied its period variation and obtained a negative rate of period change $(-2.1 \times 10^{-11} \ dc^{-2})$. However Tang et al. (1992) observed this star and obtained a positive rate of period change $(1.1 \times 10^{-11} \ dc^{-2})$.

In order to study its period change we observed this star with the 60 cm telescope at Xinglong Station of Beijing Astronomical Observatory from 30 January to 12 February 1993 and from 16 February to 4 March 1994. The Johnson V filter was used. HD 80079 was used as comparison. 16 times of maximum light obtained by us are listed in Table 1, where T_{max} is the time of maximum light in HJD, E is cycle number, W is weight. The light curves for two nights are plotted in Figure 1.

Table 1. Times of maximum light of HD 79889 (1993-1994)

No.	T_{max}	E	W
1	2449018.0768	−2.0	1.0
2	2449018.1726	−1.0	1.0
3	2449018.2685	0.0	1.0
4	2449018.3644	1.0	1.0
5	2449019.0352	8.0	1.0
6	2449021.0500	29.0	1.0
7	2449022.0079	39.0	1.0
8	2449030.0605	123.0	1.0
9	2449031.0192	133.0	1.0
10	2449400.0215	3982.0	1.0
11	2449400.1173	3983.0	1.0
12	2449401.0753	3993.0	1.0
13	2449401.1713	3994.0	1.0
14	2449413.0593	4118.0	1.0
15	2449413.1553	4119.0	1.0
16	2449416.1272	4150.0	1.0

Besides our 16 times of maximum light we collected all data of HD 79889 obtained by other astronomers (Oja, 1987; Rodriguez et al., 1990; Liu et al., 1991; Wunder et al., 1992; Tang et al., 1992). We acquired altogether 60 times of maximum light. On the base of 60 times of maximum light we calculated the improved elements of HD 79889 by the method of least squares:

$$T_{max} = HJD\, 2449018.2684 + 0^d09586954 \times E \qquad (1)$$
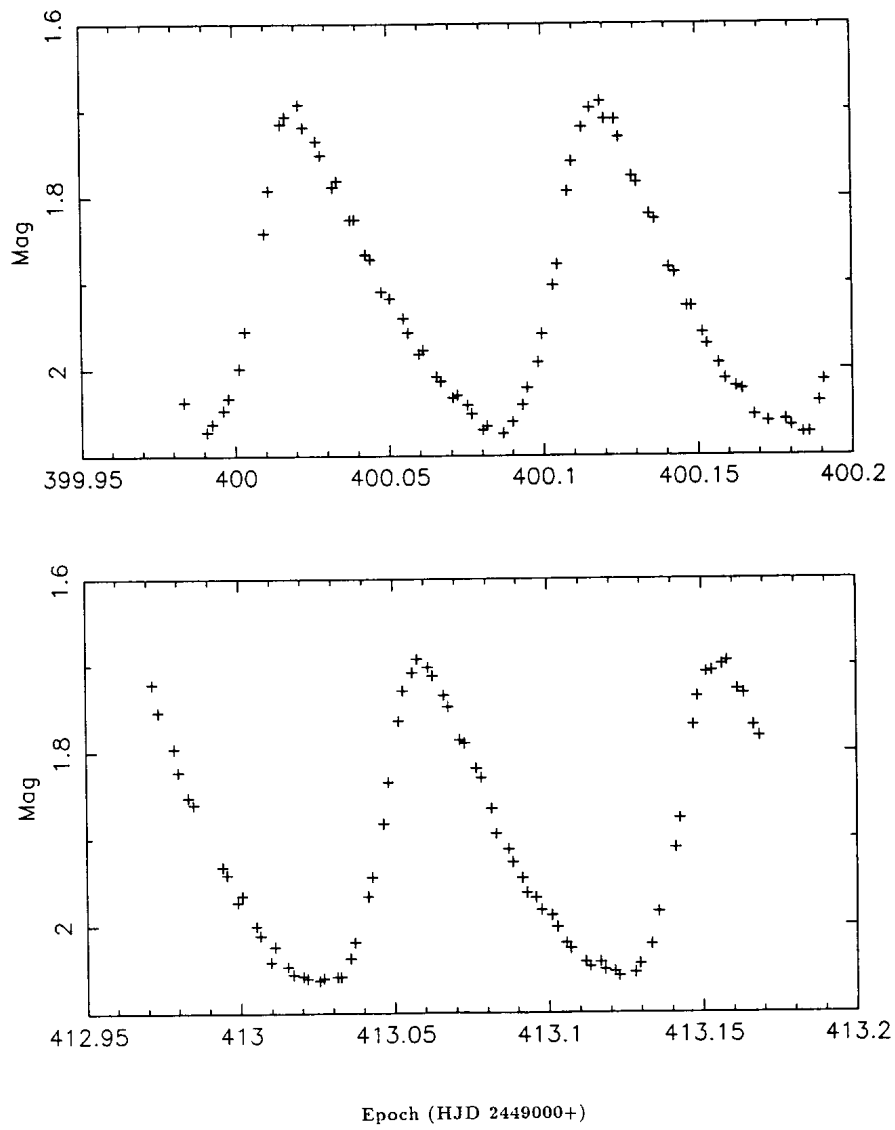
Epoch (HJD 2449000+)

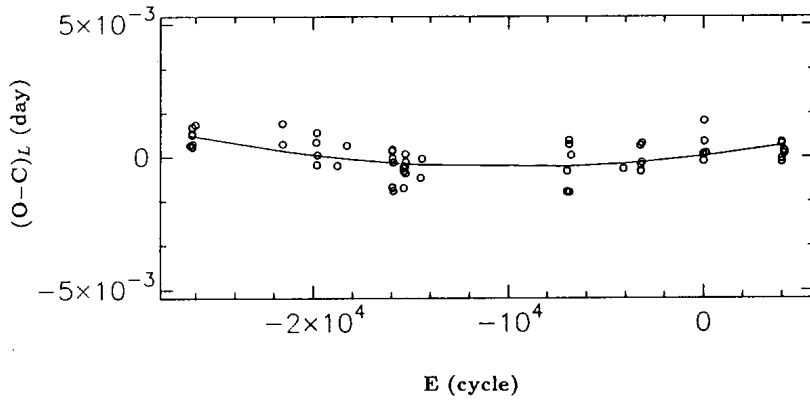Figure 1. Light curve relative to comparison star.

Figure 2. The $(O-C)_L$ diagram of HD 79889 and its fit curve.

In order to study the variations of period we used the above formula and calculated all times of maximum light. Then the residuals between observations and calculations $(O-C)_L$ were obtained. The $(O-C)_L$ were fitted with a parabola as shown in Figure 2. The parabola means variation of the period. So we obtained the equation by the method of least squares:

$$T_{max} = HJD2449018.2684 + 0^d09586963 \times E + 0.5 \times G \times E^2 \qquad (2)$$

G is the rate of period change. Its value is $8.8 \times 10^{-12}(dc^{-2})$. Since the rate of period change is positive, it means that the pulsation period is increasing. This result agrees with that obtained by Tang et al. (1992).

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NEW PERIOD AND PERIOD CHANGE OF EU HYDRAE

The eclipsing binary EU Hya was observed with the photoelectric photometer attached to the 60 cm reflecting telescope in BV bands at Yunnan Observatory during February to March, 1991. HD 74332 and HD 74309 were used as comparison and check stars, respectively. From our observations three primary minimum times were determined, which are listed in Table 1 (the last three minima).

We have collected all minimum times which could be found to calculate the new ephemeris formula

$$\text{Min.I.}=\text{JD(hel.)}2448323.1732+0\overset{d}{.}77820650\times\text{E} \qquad (1)$$
$$\pm27 \qquad\qquad \pm35$$

by means of the least squares method. This ephemeris was used in calculating the $(O-C)$I values in the Table, using these $(O-C)$I values we derived the $O-C$ diagram displayed in Figure 1. In Figure 1 a systematic trend is seen: the period became shorter continuously. In order to determine the rate of period change, all the minimum times were introduced into a quadratic least squares solution which resulted in:

$$\text{MinI}=\text{JD(hel.)}2448323.1676+0\overset{d}{.}77820374\times\text{E}-1\overset{d}{.}99\times10^{-10}\times\text{E}^2 \qquad (2)$$
$$\pm20 \qquad\qquad \pm50 \qquad \pm32$$

and the rate of period change: $dP/dE=-3\overset{d}{.}98\times10^{-10}$. With this ephemeris we computed the $(O-C)$II values in Table 1 which is shown in Figure 2. Comparing Figures 1 and 2 the quadratic ephemeris has smaller deviation than the linear one, this point could also be seen from the sums of weighted square of the deviations:

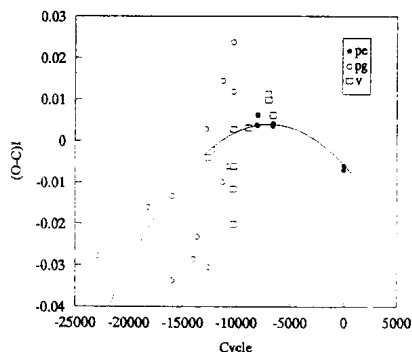$$\sum_i W^2_{(O-C)I_i} = 0.0269, \quad \sum_i W^2_{(O-C)II_i} = 0.0118$$

Figure 1. The $O-C$ diagram of the linear ephemeris,
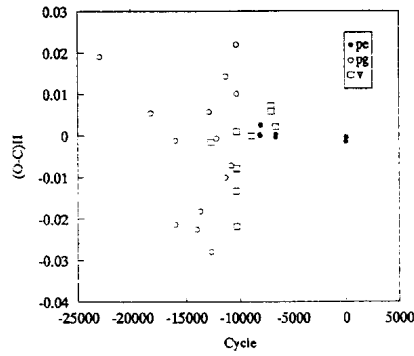the smooth curve represents the quadratic fit.

Figure 2. The O−C diagram of the quadratic ephemeris.

Table 1.

JD(Hel.)	E	(O−C)I	(O−C)II	Weight	Source
24000000+					
30470.3100	−22941	−0.0278	0.0190	3	K
34126.3360	−18243	−0.0160	0.0054	3	K
35862.4970	−16012	−0.0337	−0.0214	3	B
35876.5250	−15994	−0.0134	−0.0012	3	K
37403.3510	−14032	−0.0286	−0.0226	3	B
37669.5030	−13690	−0.0232	−0.0182	3	B
38321.6660	−12852	0.0028	0.0057	3	B
38449.2850	−12688	−0.0041	−0.0016	1	K
38473.3830	−12657	−0.0305	−0.0280	3	B
38852.3980	−12170	−0.0021	−0.0007	3	B
39507.6400	−11328	−0.0100	−0.0101	3	B
39536.4580	−11291	0.0144	0.0142	3	B
39915.4240	−10804	−0.0062	−0.0072	3	B
40290.5140	−10322	−0.0117	−0.0134	1	D
40319.3130	−10285	−0.0063	−0.0081	1	D
40319.3220	−10285	0.0027	0.0009	1	L
40319.3430	−10285	0.0237	0.0219	3	B
40322.4120	−10281	−0.0202	−0.0219	1	L
40322.4260	−10281	−0.0062	−0.0079	1	D
40326.3350	−10276	0.0118	0.0100	3	B
41410.3680	−8883	0.0031	−0.0001	1	P
42010.3660	−8112	0.0039	0.0002	30	K2
42045.3850	−8067	0.0036	−0.0001	30	K2
42080.4070	−8022	0.0063	0.0026	30	K2
42081.1850	−8021	0.0061	0.0024	30	K2
42838.3850	−7048	0.0112	0.0072	1	P
42866.3990	−7012	0.0098	0.0058	1	P
43161.3330	−6633	0.0035	−0.0004	30	K2
43189.3510	−6597	0.0061	0.0021	1	P
43196.3530	−6588	0.0042	0.0003	30	K2
43197.1330	−6587	0.0060	0.0021	30	K2
48298.2635	−32	−0.0071	−0.0015	30	G
48323.1672	0	−0.0060	−0.0004	30	G
48334.0619	14	−0.0062	−0.0005	30	G

K=Kordylewski; B=Busch; D=Diethelm; L=Locher; P=Peter; K2=Kulkarni; G=Gu

In all above calculations we assigned weight 1 to visual minimum times, weight 3 to the photographic minimum times and weight 30 to photoelectric minimum times.

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THE PHOTOMETRIC PERIOD OF THE OLD NOVA V368 AQUILAE[1]

The fast ($t_3 = 45^{\mathrm{d}}$) classical nova V368 Aql erupted in 1936 and was discovered by Tamm (1936). A minimum spectrum taken by Lynds is described by Warner (1976) to contain broad and moderately strong H and He II emission lines. This agrees with the description by Duerbeck and Seitter (1987). The spectrum published by Williams (1983) is featureless. No further observations of V368 Aql in quiescence are published. The time-resolved photometric observations of this faint ($V \approx 17\overset{\mathrm{m}}{.}2$) star presented in this Bulletin were obtained as part of a project aimed at the detection of orbital modulations in quiescent novae. The data were taken at the 0.6m–telescopes of the Laboratorio Nacional de Astrofísica (LNA), Brasopolis, Brazil. A blue-coated GEC CCD with $384{\times}576$ 22μ pixels was used at a scale of $0\overset{\prime\prime}{.}58$/pix. The seeing during the observations ranged typically from $1\overset{\prime\prime}{.}3$ to $2\overset{\prime\prime}{.}0$. An R filter (Kron-Cousins) was used to optimize photon counting statistics. Dome white spot and twilight sky flat fields as well as bias frames were taken and averaged for each run. The dark count correction was found to be negligible. A journal of observations is given in Table 1.

Table 1: Journal of observations

Date	Start (MHJD)*	Duration (hours)	Number of points	Epoch (MHJD)*
1990, May 25	48037.314	1.1	11	
1990, May 26	48038.215	3.4	30	
1990, May 27	48039.227	1.7	13	
1993, Jul 15	49183.954	5.9	49	
1993, Jul 16	49185.133	1.6	18	
1993, Jul 17	49186.109	3.5	21	
1993, Jul 18	49186.971	7.3	67	
1993, Jul 19	49188.048	5.4	53	
1993, Jul 20	49188.969	6.9	54	49189.022
1993, Aug 13	49212.960	4.3	16	
1993, Aug 26	49226.937	5.5	58	49227.002

*MHJD $\equiv$ HJD $-$ 2400000.5

The raw data were reduced using standard procedures. The instrumental magnitudes of the variable and three nearby comparison stars were derived by the PSF fitting algorithm of DAOPHOT (Stetson 1987). The presence of irregular short–term variations due to flickering confirms the identification of Duerbeck (1987). The right ascension and declination offsets in arcseconds to the comparison stars C1, C2 and C3 are $(-10,-57)$, $(-2,41)$ and $(-6,22)$, respectively. Our comparison C3 corresponds to star #3 in Klemola's (1968) finding chart.

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[1]Based on observations made at the Laboratório Nacional de Astrofísica/CNPq, Brasil
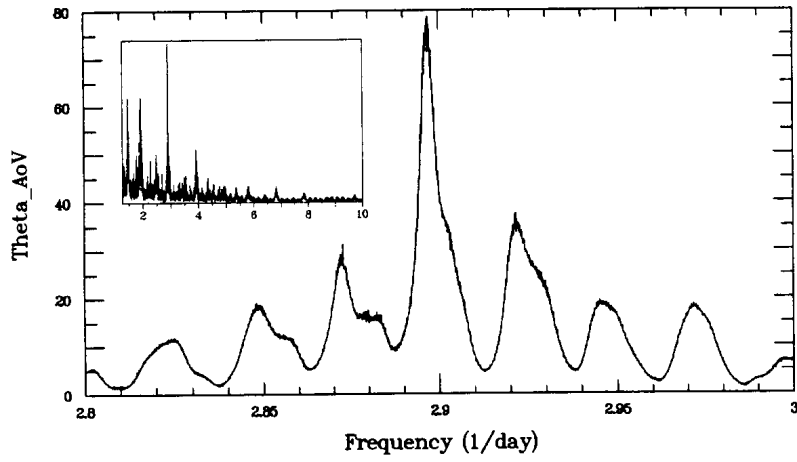
Fig. 1: AoV periodogram of the 1993 data. The peak close to 2.9 day^{-1} corresponds to the binary period. The inset shows the periodogram over a wider range in frequencies.
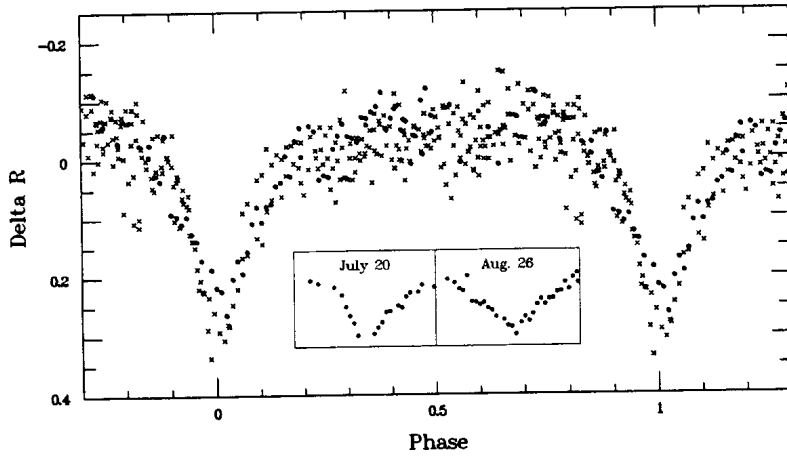

Fig. 2: Phase-folded differential light curve of V368 Aql for $P = 0.34521$ days. Crosses and dots refer to 1993, July and Aug., respectively. The insets show the two fully observed eclipses on the same scale.

The light curves of 1993, July 20 and Aug. 26 show minima with a depth of $\approx 0^{m}\!.25$. Their epochs were measured by fitting a polynomial to the minima and are quoted in Table 1. During other nights, ingresses or egresses of such minima were observed. We subjected the 1993 data to a periodogram analysis using the AoV algorithm of Schwarzenberg-Czerny (1989). The resulting periodogram (Fig. 1) shows a strong maximum close to the frequency of 2.9 days^{-1} along with some alias peaks. The inset in Fig. 1 shows a larger part of the periodogram on a compressed scale. A fit of a high order polynomial to the principal periodogram peak yields a period of

$$P = 0.34521 \pm 0.00015 \, \text{days} = 8^{h}17^{m}6^{s} \pm 13^{s}$$

The data, folded on this period, are shown in Fig. 2. Long–term variations have been subtracted before folding. Crosses and dots correspond to the observations of 1993, July and Aug., respectively. The minimum epoch of July 20 was chosen as zeropoint of phase. The scatter in the data is largely due to real variations; the RMS residuals obtained from comparison stars with similar brightness is $0^{m}\!.03$. The period error is a conservative estimate. It yields a phase shift of 0.05 between the well covered minima of July 20 and Aug. 26 which would easily be detected in the folded light curve. The measured minima epochs yield the same period as the periodogram analysis within the errors if 110 cycles are assumed to have elapsed between the July and August minima. The alias periods can be rejected because the light curves folded on them are unacceptable. The observing runs of 1990, May 25 were all rather short and do not contain eclipses. Since the period is not known with enough precision to calculate phases for these data they are not shown in Fig. 2. The insets in Fig. 2 show the individual eclipses of 1993, July 20 and Aug. 26 on the same scale. The total phase range is $-0.2 \ldots 0.2$. It is seen that the shape of the minima can vary considerably.

We interpret the light curve minima as eclipses of the primary component of V368 Aql by the secondary. The period is then the orbital period which is quite large for a cataclysmic variable (CV). According to the canonical model the secondary should then contribute an appreciable fraction to the total light. This is compatible with the spectrum shown by Williams (1983) which is flat or even slightly inclined to the red. The phase folded light curve shows no evidence of an orbital hump before the eclipse while the eclipse itself appears to be slightly asymmetric.

The ingress and egress phases of the eclipses not being well defined, their total width cannot be easily measured. It is of the order of 0.2 in phase which appears to be rather large for a CV. However, such a width is not impossible. Assuming the secondary to be on the main sequence (although at such a long period this assumption may be violated to a certain degree), the period – secondary mass relation for CVs predicts $\mathcal{M}_{\text{sec}} \approx 1 \, \mathcal{M}_{\odot}$. Assuming further a large mass ratio of $\mathcal{M}_{\text{sec}}/\mathcal{M}_{\text{prim}} \approx 1$ (but not larger in order to permit stable mass transfer), the accretion disk to reach out to 70% of the mean Roche lobe radius of the primary, and the orbital inclination to be close to 90°, the phase difference between first and last contact of the disk eclipse is ≈ 0.18, compatible with the observations. Totality would last only 0.035 in phase which (in view of the scatter of the data) is also not in contradiction with the observations. The small depth of the eclipses of only $\approx 0^{m}\!.25$ appears to be a problem if a total eclipse is required to explain their width. But this is not necessarily the case. Assuming the disks in quiescent novae to be similar to those of dwarf novae in outburst, the M_V –

P relation of Warner (1987) predicts $M_V = 3^m\!.50$ for a mean orbital inclination. Let the secondary have the absolute magnitude and colours of the sun, we find from Allen (1973) that $M_{R,\text{sec}} = 4^m\!.31$. The primary is assumed to have $V - R \approx 0$ (Leibowitz et al. 1994). The depth then yields $M_{R,\text{prim}} = 5^m\!.8$ if the eclipses are total. Using the correction formula for orbital inclinations of Paczyński and Schwarzenberg-Czerny (1980), the above numbers are compatible if $i \approx 84°$. Thus, the large eclipse width and its low depth can be explained within the canonical model of CVs. A high quality spectrum of V368 Aql which should be dominated by a roughly solar type component would show whether this scenario is viable or not.

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UBVR PHOTOMETRY OF THE SYMBIOTIC STAR AG Dra IN ITS 1994 OUTBURST

AG Draconis is a symbiotic binary with an orbital period of $\sim$552.4 days (Skopal 1994a) consisting of a relatively early cool component of spectral type $<$ K4III (Kenyon & Fernandez-Castro 1987) and a compact hot component of $T \sim 1.2\times10^5$ K (Mürset et al. 1991). Since 1930, AG Dra has exhibited a series of outbursts – in 1936, 1951, 1966, 1980, 1985. The light curve of each outburst has a double peaked profile with the peak separation of $\le P_{\mathrm{orb}}$, and the minimum located close, but slightly shifted after the spectroscopic conjunction – cool component in front. Luthardt (1983) found that the brighter outburst lasts a longer time.

In 1994 June, the visual magnitude estimates indicated that AG Dra has entered the new bright outburst (IAU Circ. 6009). Viotti, Gonzales-Riestra & Rossi (1994) observed AG Dra with the IUE satellite at the end of June and the beginning of July. They found that the ultraviolet spectrum is qualitatively similar to that of the 1980 outburst, but the line and continuum fluxes appear more intense. Optical spectrum exhibits a hot continuum with very strong HI, HeI and HeII 468 nm emissions. Balmer lines display P-Cyg absorption at -220 km/s and emission wings extended to $\sim \pm$ 400 km/s (Viotti 1994).

In our contribution we present the $UBVR$ photoelectric photometry confirming the current bright outburst of AG Dra. The observations were made in the standard UBV system using a one-channel photoelectric photometer installed in the Cassegrain focus of the 0.6/7.5 m reflectors of the Skalnaté Pleso, Stará Lesná and Hlohovec Observatories. The stars BD+67°925 (V=9.88, $B - V$=0.56, $U - B$=-0.04), HD 145991 (V=9.26, $B - V$=0.74, $U - B$=0.31) and SAO 16935 (m_{v}=9.8, m_{pg}=10.6) were used as the comparison and the check stars, respectively. For details of observations see Skopal et al. (1990). Observations of AG Dra are collected in Table 1. Observations at Hlohovec observatory were taken by Petrík and Karlovský (1994). Figure 1 shows the UBV photometry according to the data published in the literature, and covering the period of 1980 to 1994 August. During the current outburst, the star's brightness reached a maximum on July 16, 17 when $U \sim$7.7-7.6, $B \sim$8.8 and $V \sim$8.5. Such values correspond to the very bright outburst of AG Dra. The measurements made at the end of July and in August display a gradual decrease of the star's brightness in all filters (Fig. 2). In accord with the shape of the light curve observed during outbursts, we predict the same development of the optical continuum as, for example, in the 1980 outburst. The star's brightness should reach a minimum in 1995 January, afterwards, following an increase peaked sometimes in the summer of 1995, should decline from the outburst.
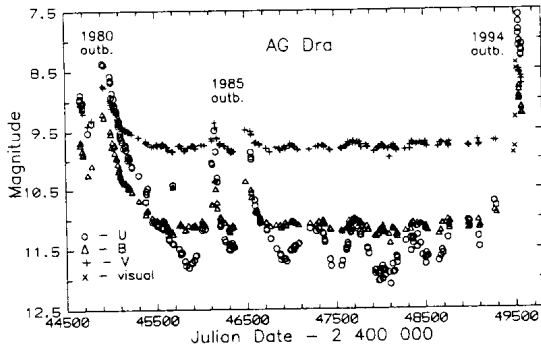
Figure 1. UBV light curves of AG Dra covering the period of 1980 to 1994 August.
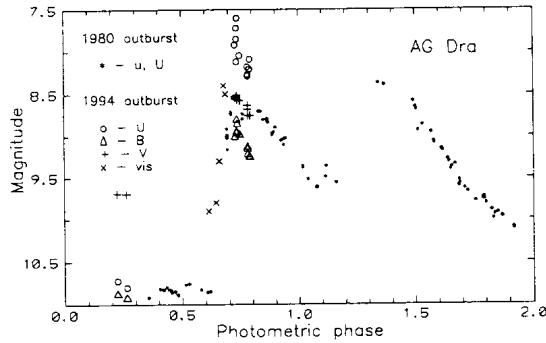

Figure 2. Compiled u and U light curve of the 1980 outburst compared to the UBV and visual photometry of the current (1994) outburst. The ephemeris for the minima in U was taken after Skopal (1994a).
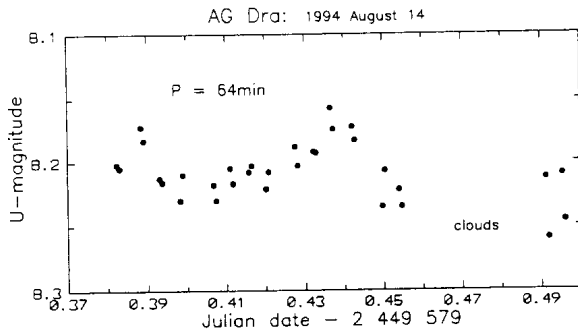

Figure 3. Observation in the U light made on 1994 August 14.

Table 1

UBVR photometry of AG Dra

Date	Julian Date	U	B	V	ΔR	Obs
1993 Oct 5	49266.49	10.727	10.869	9.692		SP
1993 Oct 27	49288.40	10.805	10.915	9.695		SP
1994 Jul 12	49545.55	7.92	9.00	8.55		H
1994 Jul 14	49548.47	8.12	8.93	8.52		H
1994 Jul 15	49549.45	7.85	8.79	8.55		H
1994 Jul 16	49549.51	7.72	8.95	8.51		H
1994 Jul 16	49550.47	7.60	8.84	8.57		H
1994 Jul 23	49556.52	8.046	8.969	8.575	-1.504	SP
1994 Aug 9	49574.48	8.273	9.116	8.673	-1.436	SP
1994 Aug 10	49575.41	8.270	9.207	8.749	-1.395	SP
1994 Aug 14	49579.43	8.207	9.233	8.754		SL
1994 Aug 15	49580.37	8.09	9.24	8.75		H

$\Delta R = $ AG Dra $-$ BD$+67°925$

Observatory: SP – Skalnaté Pleso, SL – Stará Lesná, H – Hlohovec

Our observation taken on 1994 August 14/15 at Stará Lesná shows ~0.05 mag variations in the U band with the period of ~64 minutes (Fig. 3). No short-term flickering variability was indicated. If this is a rotational period, then the U pseudophotosphere has the radius of ~0.5 $R_\odot$ (for Keplerian rotation and $M_{hot} = 1 M_\odot$), which is similar to ~0.1-0.2 $R_\odot$ derived by Leibowitz & Formiggini (1992) for the 1980 outburst (the hot component luminosity in quiescence of 15 $L_\odot$ was adopted after Mürset et al. [1991]).

Skopal (1994b) suggested that the major increase in the star's brightness and the phase dependent light variation developed during the outburst of AX Per are caused by the emission region on the cool component hemisphere facing the hot component and its differing visibility in different orbital phases of the binary. This effect results from collision of the mass ejected by the hot component with the red giant atmosphere. Hydrogen flash on the white dwarf surface causes an increase of the hot component radius, which fills up the critical surface very easily because of nonsynchronous rotation, and triggers the mass transfer from the hot component to the cool one. The same model can be applied to AG Dra because both mass outflow from, and rotation of the outbursting star are directly observed in the AG Dra spectrum. Moreover, Leibowitz & Formiggini (1992), analysing spectral energy distribution in the 1980 outburst, revealed that outbursts of AG Dra are triggered by events in the atmosphere of the cool giant, associated with the liberation of mechanical energy. All these facts strongly support the above mentioned idea on the nature of the wave-like modulation of the light developed during outbursts in some symbiotic stars.

AG Dra is currently included in the observing programme of the Skalnaté Pleso Observatory. The further data will be published in Contrib. Astron. Obs. Skalnaté Pleso, 25 within the long-term observational campaign of symbiotic stars.

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UBV PHOTOMETRY OF FY Per

FY Per was discovered as a variable star by Morgenroth (1936). Some results of investigation of this nova-like cataclysmic variable are published by Shugarov (1980). Recently Sazonov and Shugarov (1993) have discovered that the system's light changes with a period of 1^h33^m and an amplitude of $0\overset{m}{.}15$ in B band.

FY Per has been observed with the 60 cm telescope and computer controlled photometer of the National Astronomical Observatory Rozhen on several occasions. BD $+50°1032$ has been used as a comparison star. Each integration was 10 sec through the B filter. In spite of the changes from night to night, the brightness has remained almost constant on the individual nights, and we have not detected any variations on a time scale of $\sim$1-2 hours and amplitude larger than $0\overset{m}{.}035$.

Table 1

Date	UT	N pts	B	σ
18 Dec. 1993	$20^h07^m - 23^h27^m$	994	$12\overset{m}{.}82\text{-}12\overset{m}{.}86$	0.012
19 Dec. 1993	18 43 - 22 20	1135	12.96-12.99	0.013
21 Dec. 1993	22 35 - 22 53	88	13.08-13.10	0.013

Additionally five UBV estimates were obtained:

Table 2

JD 2440000+	V	B−V	U−B
9340.49	12.55	0.29	−0.47
9341.45	12.68	0.30	−0.43
9343.44	12.74	0.35	−0.41
9357.42	12.53	0.30	−0.48
9366.48	12.69	0.35	−0.37

The photometric data here in were reduced using APR sofware system (Kirov et al., 1992).

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PHOTOELECTRIC OBSERVATIONS OF GR TAURI

GR Tau (=BD+20°0685) was discovered as an eclipsing binary by Strohmeier et al. (1957). Yamasaki and Okazaki (1984) published the first photoelectric light curves and the radial velocity curves with the revised spectral type A5 V and the orbital period P=0.4298525 days for the system. The remarkable characteristics of GR Tau are its short orbital period and asymmetric light curve with total eclipse. The photometric solution obtained by Yamasaki and Okazaki (1984) showed that the system might be a noncontact but near-contact detached binary.

The new photoelectric BV observations were carried out with the single-channel photon-counting photometer at the 60 cm telescope of Beijing Astronomical Observatory during the 1985 and 1993 seasons. The stars BD+20°0684 and BD+19°0642 were used as the comparison and check star, respectively. All the observations were corrected for differential extinction and transformed into the standard Johnson UBV system. Two sets of complete BV light curves and three primary minima were obtained. Using the new times of minima, together with all published p.e. minima as listed in Table 1, a new linear ephemeris was derived as follows:

$$\text{Min.I.} = \text{HJD } 2446415.0208 + 0^{d}_{\cdot}42985142 \times E \qquad (1)$$
$$\pm 3 \qquad \pm 7$$

The O−C values in Table 1 are calculated from new ephemeris (1) and are all plotted in Figure 1. It shows that the period of GR Tau appears to have appreciable long-term changes. Therefore, a quadratic fitting of minima is carried out by the least squares method, which gives the following ephemeris:

$$\text{Min. I} = \text{HJD } 2446415.0216 + 0^{d}_{\cdot}42985146 \times E - 6^{d}_{\cdot}26 \times 10^{-11} \times E^2 \qquad (2)$$
$$\pm 4 \qquad \pm 6 \qquad \pm 2.12$$

The fit of the quadratic ephemeris (2) to the observations is also shown in Figure 1. The rate of the period decrease of GR Tau turns out to be $\Delta P/P = -2.91 \times 10^{-10} (\sim 0.0092$ sec/yr).

By using the linear ephemeris (1), the observations in 1993 were combined into B and V normal light curves as shown in Figure 2. The light curves exhibit obviously asymmetry with the Max I brighter than the Max II by about 0.05 in V and 0.07 in B. The behaviour of the light curve remains almost the same as that observed in 1980 by Yamasaki and Okazaki (1984) and in 1989 by Hanžl (1990) and no migration of the distortion on the light curves was found yet. The asymmetry of the light curve is probably due to the mass transfer in the system.
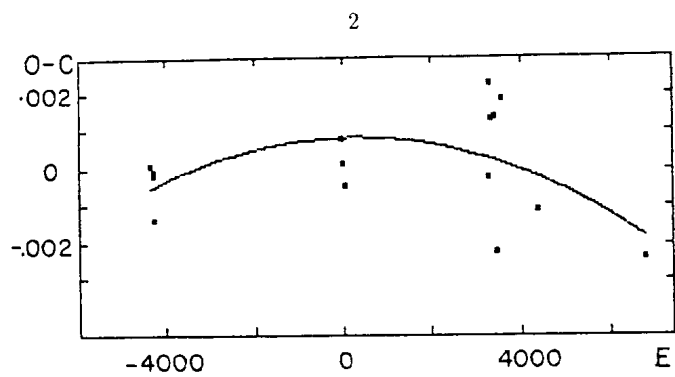
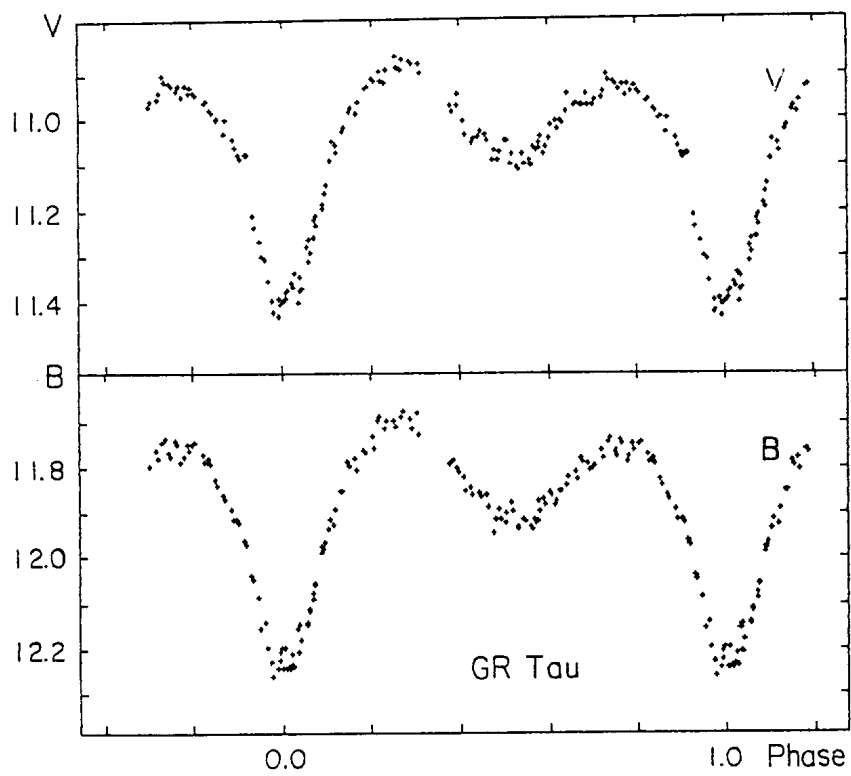Figure 1. O–C diagram of minimum times for GR Tau.

Figure 2. BV light curves of GR Tau in 1993.

Table 1
The times of minima and their O−C values

JD(Hel.)2440000+	E	O−C	Source
4544.3075	−4352	0.0001	Yamasaki and Okazaki (1984)
4573.1074	−4285	0.0000	//
4578.2643	−4273	−0.0014	//
4579.1252	−4271	−0.0002	//
6414.1619	−2	0.0008	This paper
6415.0209	0	0.0001	//
6438.6622	55	−0.0004	Mullis and Faulkner (1991)
7821.4944	3272	−0.0002	Wunder et al. (1992)
7827.5148	3286	0.0023	Hanžl (1990)
7849.4363	3337	0.0013	//
7881.6752	3412	0.0014	Mullis and Faulkner (1991)
7889.4089	3430	−0.0023	Hanžl (1990)
7945.2937	3560	0.0019	Hanžl (1991)
8288.3122	4358	−0.0011	Agerer (1991)
9334.1394	6791	−0.0024	This paper

The further photometric analysis of the light curves will be published in a forthcoming paper.

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PHOTOMETRY OF THE ECLIPSING BINARY FK ORIONIS

The eclipsing binary FK Ori (=41.1934=HD 240601; m=11.8-13.8pg; Sp:A2) was discovered by Morgenroth (1934). He observed three moments of weakenings and then the variable was classified as an Algol type. The full light curve was obtained by Szafraniec (1974) by only visual method. No brightness decrease was observed at the secondary minimum. According to the GCVS the orbital period of the binary is changing and its ephemeris is

$$\text{Min I} = \text{HJD } 2445680.512 + 1\overset{d}{.}947529 \times E \tag{1}$$

Our UBVR photometric observations of FK Ori were obtained with the 0.6 m telescope at Mt. Maidanak in 1989/92. The comparison star BD+8°852 (V=7$\overset{m}{.}$33; U−B=−0$\overset{m}{.}$27; B−V=−0$\overset{m}{.}$09; V−R=−0$\overset{m}{.}$05; Sp:B9) and the check star BD+9°627 (V=10$\overset{m}{.}$09; U−B= 0$\overset{m}{.}$93; B−V=1$\overset{m}{.}$11; V−R=0$\overset{m}{.}$58) were chosen. We determined the probable error of a single measurement of the variable to be 0$\overset{m}{.}$042 in U, 0$\overset{m}{.}$009 in B, 0$\overset{m}{.}$012 in V and 0$\overset{m}{.}$020 in R. 78 points in U and nearly 240 points in each BVR filter were made. We analyzed all published times of minima and calculated the following ephemeris:

$$\text{Min I} = \text{HJD } 2426988.565 + 1\overset{d}{.}9474226 \times E + (61 \pm 2)^d \times 10^{-10} \times E^2 \tag{2}$$
$$\pm 0.005 \pm 0.0000028$$

The O−C residuals are listed in Table 1 and shown in Figure 1. The period of FK Ori increases at a rate of 0$\overset{d}{.}$00000115 per year.

However, the times of minima after JD 2437500 are better described by the ephemeris from GCVS. We noted the residuals $(O-C)_1$ in the last but one column of the Table. Perhaps, the period change is uneven. The light curves of FK Ori in U, B, V, R are shown in Figure 2. The duration of the primary minimum is 0$\overset{p}{.}$14 and the partial eclipse has been observed. The secondary minimum is very shallow and its duration is practically equal to the primary one.

We also observed the important details at the secondary minimum in U and B. The brightness of the star increased almost by 0$\overset{m}{.}$2 in U and 0$\overset{m}{.}$1 in B. These measurements were obtained in 1991. In 1992 most observations were made in BVR and we did not see any anomalies at these phases. In general the observations of the binary showed a wider scatter in 1991 than in any other years. Perhaps, a large hot spot was on the surface of the secondary component in 1991.
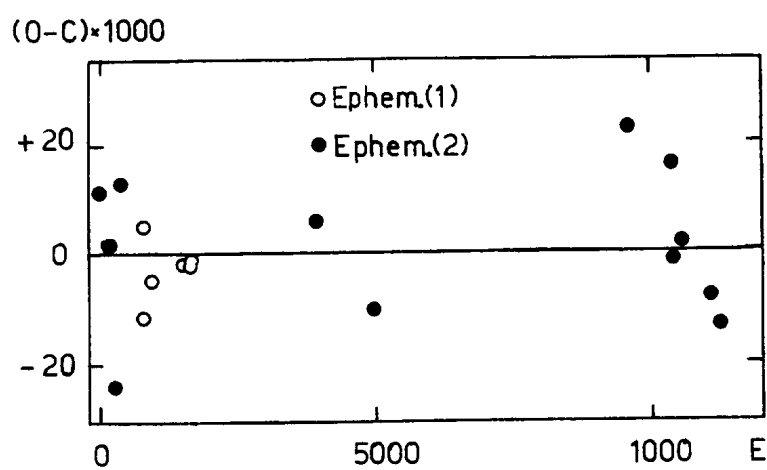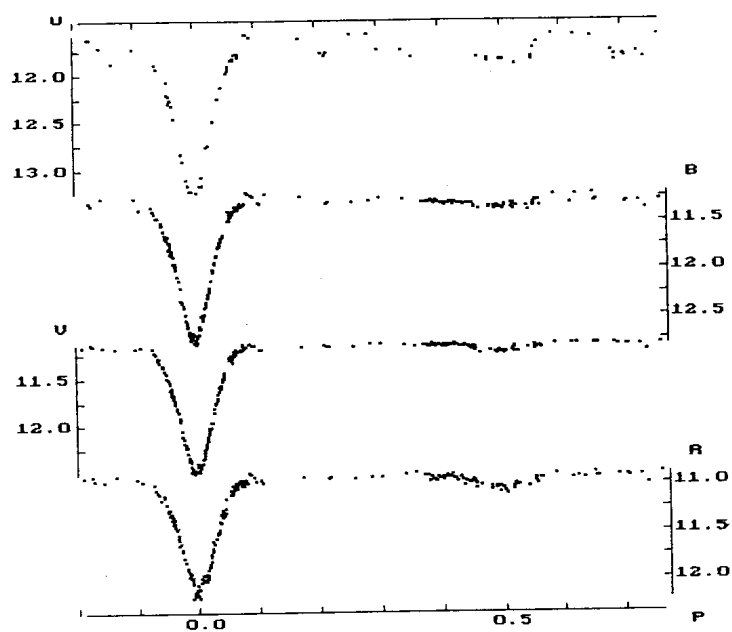
(O-C)×1000

Figure 1. O—C diagram for FK Ori

Figure 2. The light curves of FK Ori

Table 1. Times of minima of FK Ori

Observer	Type	HJD 2400000+	O–C	E	(O–C)$_1$	E$_1$
Morgenroth (1934)	pg	26988.576	+0$^{\rm d}$011	0		
		27360.525	+0.002	191		
		27479.292	−0.024	252		
Piotrowski (1935)	v	27773.390	+0.013	403		
Szafraniec (1974)	v	33744.30	+0.05:	3469		
		34661.511	+0.006	3940		
		36630.394	−0.010	4951		
GCVS	pg	45680.512	+0.023	9598	0$^{\rm d}$000	0
Manek (1992)	v	47207.363	−0.001	10382	−0.011	784
Dedoch (1992)	v	47207.380	+0.016	10382	+0.005	784
Borovichka (1992)	v	47542.345	+0.002	10554	−0.005	956
present paper	pe	48541.430	−0.008	11067	−0.002	1469
		48915.356	−0.013	11259	−0.002	1661
		48917.304	−0.013	12260	−0.001	1662

Table 2. Photometric values of FK Ori

	V	U–B	B–V	V–R
Max	11.15	+0.47	0.13	0.23
Min I	12.50	0.50	0.24	0.37
Min II	11.24	0.50	0.12	0.14

In Table 2 we list the average photometric characteristics of the curves.

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PHOTOMETRY OF THE SHORT PERIOD ECLIPSING BINARY
FR ORIONIS

FR Ori (=282.1934=HD 248406; m=11.0-11.9pg; Sp:A7) was discovered photograph-
ically by Hoffmeister (1934) to be a short period variable. Soloviev (1937), having used
his visual observations, determined a period of the binary with high accuracy. The star
was observed visually by Szafraniec (1974) and photographically by Gaposhkin (1954).
The following ephemeris of FR Ori is given in the GCVS:

$$\text{Min I} = \text{HJD } 2427862.159 + 0\overset{d}{.}88316217 \times E$$

Our observations of the binary were obtained with the 0.6m telescope at Mt. Maid-
anak in 1989/92. The star BD+9°972 (V=9$\overset{m}{.}$46; U−B=0$\overset{m}{.}$069; B−V=0$\overset{m}{.}$32, V−R=0$\overset{m}{.}$18;
Sp:F2) was chosen as a comparison one. The total number of the observations are 144
in U, 181 in B, 183 in V and 176 in R. Having used all published times of minima we
improved the ephemeris of the binary by the method of the least squares:

$$\text{Min I} = \text{HJD } 2432508.4774 + 0\overset{d}{.}88316188 \times E$$
$$\pm 0.0002 \pm 0.00000004$$

The O−C residuals are given in Table 1 and shown in Figure 1. The light curves of
FR Ori are shown in Figure 2. In Table 2 we list the main characteristics of the curves.
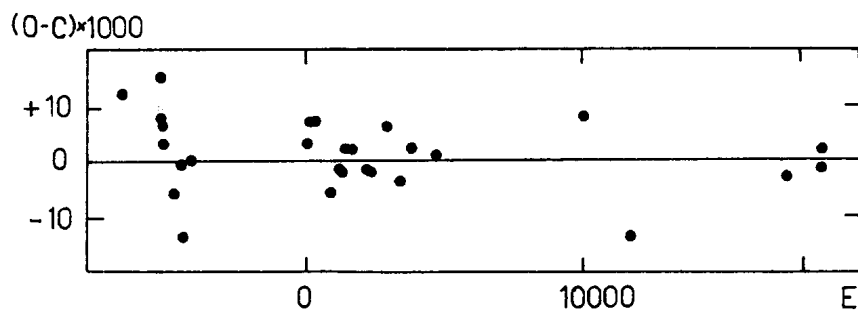

Figure 1. O−C diagram for FR Ori.

Table 1. O−C residuals for FR Ori.

Observers	Type	HJD 2400000	E	O−C
Soloviev (1937, 1951)	pg	24845.289	−8677	0.^{d}012
	v	27846.277	−5279	0.015
		27862.165	−5261	0.006
		27869.231	−5253	0.007
		27892.190	−5227	0.003
		28155.363	−4929	−0.006
		28488.320	−4552	−0.001
		28510.386	−4527	−0.014
		28824.806	−4171	0.000
Szafraniec (1974)	v	32508.479	0	0.003
		32615.345	121	0.007
		32894.424	437	0.007
		33265.339	857	−0.006
		33596.529	1232	−0.002
		33681.312	1328	−0.002
		33689.265	1337	0.002
		34043.413	1738	0.002
		34452.313	2201	−0.002
		34685.468	2465	−0.002
		35071.418	2902	0.006
		35473.247	3357	−0.004
		35904.236	3845	0.002
		36629.311	4666	0.001
Klimek (1972)	v	41368.366	10032	0.008
Kreiner, Mirtzcka (1980)	v	42812.314	11667	−0.014
Dedoch (1992)	v	47868.429	17392	−0.003
present paper	pe	48572.311	18189	−0.001
		48926.458	18590	−0.002
		48927.345	18591	0.002

Table 2. Photometric parameters of FR Ori.

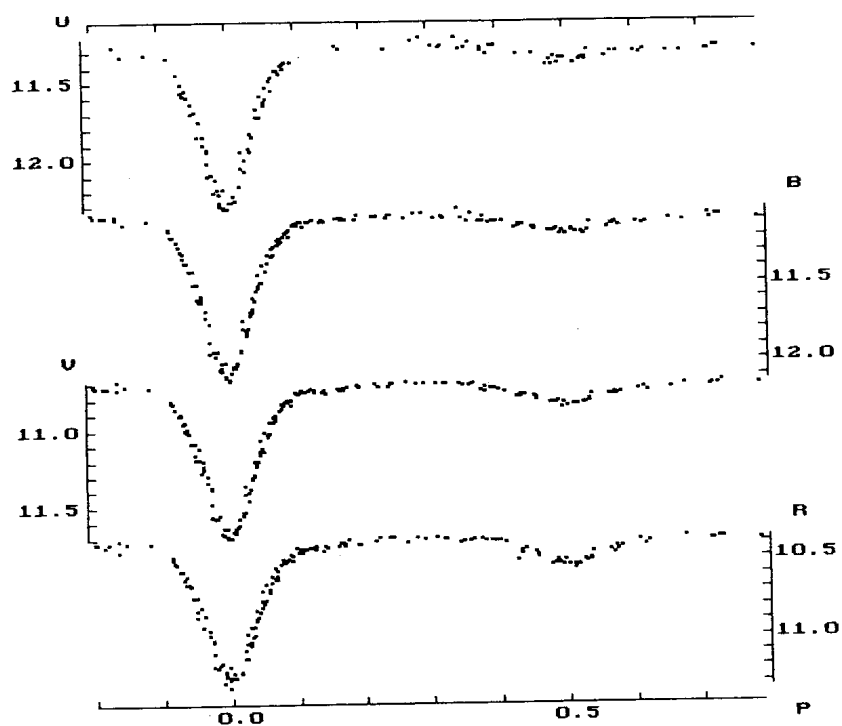|	V	U−B	B−V	V−R
Max	10.71	+0.18	0.37	0.34
Min I	11.70	0.20	0.41	0.43
Min II	10.84	0.17	0.34	0.31

Figure 2. The light curves of FR Ori.

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Kreiner, J. M., Mirtzcka, A., 1980, *Astron. Nachr.*, **301**, 327
Soloviev, A. V., 1937, *Tadjik Obs. Circ.*, No. 25, 3
Soloviev, A. V., 1951, *Peremen. Zvezdy*, **8**, 50
Szafraniec, R., 1974, *Acta Astron.*, **24**, 89

PHOTOELECTRIC OBSERVATIONS OF
VV Ori IN R AND I

VV Ori (BD−1°943) is a β Lyr type eclipsing binary, consisting of two main sequence stars of spectral type B.

The observations were performed during 55 nights between December 1990 and February 1994. The total number of observations obtained are 2692 points for each color (Table 1).

Throughout the author's observations, HR 1873 (BD−1°949, sp=B3V) was used as the comparison star and HR 1861 (BD−1°935, sp=B1V) was used as a check star, which are the same ones as used in the previous work by Duerbeck (1975). However, from the author's observations it was found that HR 1873 abruptly changed its brightness in January 1992.

The constancy of the star HR 1861 was verified by Huffer and Kopal (1951), Duerbeck (1975) and Chambliss (1982). All the observations have been transformed to Johnson's standard system. The obtained light and color curves in R and I between 1993 and 1994 are shown in Figure 1.

The obtained new times of minima and previous ones derived by other authors (see Duerbeck, 1975) are shown in Table 2. We have obtained the new light elements:

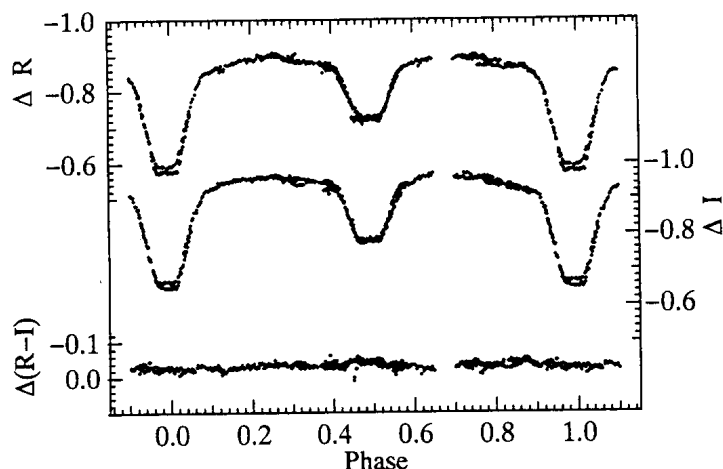$$\text{Min I(Hel J.D.)} = 2440890.5112 + 1\overset{d}{.}48537752 \times E$$

Figure 1. Light and color curves of VV Ori

Table 1. The data of present observations (VV Ori)

Season	Nights	Data points	minima I	minima II
1990 Dec. – 1991 Feb.	11	449	2	0
1991 Nov. – 1992 Feb.	15	755	0	1
1992 Nov. – 1993 Feb.	18	844	1	2
1993 Nov. – 1994 Feb.	11	644	2	2

Table 2. New times of minima of VV Ori

| Year	J.D. (Hel.)	E	O – C	Author
	24...			
1913	19836.021	-14174.5	-0.007	Daniel
1913	20095.2218	-14000	-0.0041	Hertzsprung
1922	23401.680	-11774	0.004	Stearns
1930	26035.251	-10001	0.000	Zverev
1931	26387.282	-9764	-0.003	Dufay
1934	27443.3878	-9053	-0.0007	Martin
1934	27464.184	-9039	0.000	Schneller
1938	29225.849	-7853	0.008	Wood
1938	29234.756	-7847	0.002	Wood
1939	29307.539	-7798	0.002	Wood
1939	29335.758	-7779	-0.002	Wood
1969	40545.899	-232	-0.005	Atkins
1973	42041.6826	775	0.0038	Duerbeck
1976	42788.8291	1278	0.0054	Chambliss
1976	42791.8018	1280	0.0074	Chambliss
1976	42794.7704	1282	0.0052	Chambliss
1976	42803.6832	1288	0.0058	Chambliss
1978	43510.7218	1764	0.0047	Chambliss
1990	48249.0735	4954	0.0021	Arai
1990	48255.0144	4958	0.0014	Arai
1992	48636.0120	5214.5	-0.0003	Arai
1992	48962.0520	5434	-0.0007	Arai
1992	48982.1030	5447.5	-0.0023	Arai
1992	48988.0447	5451.5	-0.0021	Arai
1993	49320.0262	5675	-0.0024	Arai
1993	49337.1077	5686.5	-0.0028	Arai
1993	49340.0805	5688.5	-0.0007	Arai
1994	49372.0115	5710	-0.0053	Arai
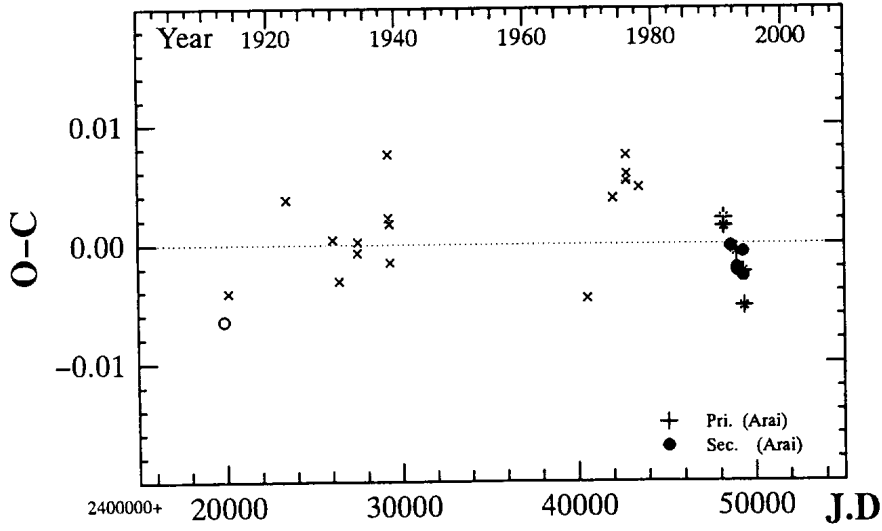
Figure 2. O−C diagram of VV Ori (1913-1994)

Table 3. Δ R, Δ I and Δ (R-I) values of VV Ori
at maxima and minima

phase	Year	Δ R	Δ I	Δ (R-I)
	1991	-0.879	-0.835	-0.044
maxima I	1992	-0.886	-0.858	-0.028
	1993	-0.880	-0.849	-0.031
	1994	-0.900	-0.864	-0.035
	1991	-0.577	-0.557	-0.020
minima I	1992	-0.580	-0.562	-0.018
	1993	-0.580	-0.552	-0.028
	1994	-0.586	-0.557	-0.029
	1991	-0.902	-0.869	-0.033
maxima II	1992	-0.876	-0.843	-0.033
	1993	-0.896	-0.849	-0.047
	1994	-0.895	-0.857	-0.038
	1991	-0.730	-0.693	-0.037
minima II	1992	-0.725	-0.690	-0.036
	1993	-0.723	-0.682	-0.041
	1994	-0.727	-0.682	-0.045

4

Figure 2 shows the O−C diagram where the data of other authors are also plotted. Table 3 shows the variations of ΔR, ΔI at maxima and minima respectively.

I would like to express my hearty thanks to Prof. M. Kitamura and Dr. A. Okazaki for valuable suggestions and encouragement.

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[1] JAPOA: Japan Amateur Photoelectric Observers Association

FURTHER PHOTOELECTRIC OBSERVATIONS
OF VW Cep IN R AND I

The present report announces a sequel of the report which appeared in a previous issue of this publication (Arai, 1991). We wish to report on several findings resulting from our observations of the variation of time of minima over several years.

As before, the observations were made with the 28-cm (f=2,800mm) Schmidt Cassegrain telescope, equipped with a single channel R I photometer (SSP-3, Optec Inc.) and Schott standard filters. The observations were performed altogether during 31 nights between December 1989 and November 1993. The total number of observations obtained were 1514 points for each color (Table 1).

Throughout the course of the present observations we assumed constancy of the brightness of BD+74°889.

All the observations have been transformed to Johnson's standard system. The obtained light and color curves in R and I in 1993 are shown in Figure 1.

Figure 2 shows the O−C diagram where the data of Glownia (1988), Lloyd et al. (1992), Navratil (1994), Vinkó (1989, 1993) and Wunder (1992) are also plotted together. Figure 2 clearly indicates that the period abruptly changed in about 1990, being in agreement with the previous result by Lloyd et al. (1992). We obtained the new light elements:

$$\text{Min(Hel. JD)}=2448155.0724+0\overset{d}{.}27830526\times E$$

Figure 3 depicts the variations of ΔR, ΔI at maxima and minima respectively. It is noticeable from Figure 3 that the maxima I and II have clearly changed between 1992 and 1993.

Table 1. The data of present observations

Season	Nights	Data points	minima I	minima II
1989 Dec. − 1990 Jan.	9	499	4	2
1990 Sep. − 1990 Nov.	6	271	5	2
1991 Nov. − 1991 Dec.	6	234	4	2
1992 Oct. − 1992 Nov.	6	340	4	5
1993 Oct. − 1993 Nov.	3	170	3	2

Table 2. New times of minima of VW Cep

| Filter :	R			I	
Hel. J.Day	E	O-C	Hel. J.Day	E	O-C
244...			244...		
7892.0693	-945	-0.0046	7892.0698	-945	-0.0041
7895.9649	-931	-0.0053	7895.9641	-931	-0.0061
7896.9416	-927.5	-0.0027	7896.9403	-927.5	-0.0040
7899.0270	-920	-0.0046	7899.0274	-920	-0.0042
7905.0135	-898.5	-0.0016	7905.0121	-898.5	-0.0030
7912.9418	-870	-0.0050	7912.9439	-870	-0.0029
8155.0724	0	0.0000	8155.0735	0	0.0011
8185.9649	111	0.0006	8185.9650	111	0.0007
8191.9483	132.5	0.0005	8191.9486	132.5	0.0008
8200.9943	165	0.0015	8200.9940	165	0.0012
8206.0017	183	-0.0006	8206.0019	183	-0.0004
8206.1428	183.5	0.0014	8206.1423	183.5	0.0009
8219.9146	233	-0.0029	8219.9170	233	-0.0005
8600.0835	1599	0.0010	8600.0834	1599	0.0010
8602.0300	1606	-0.0007	8602.0307	1606	0.0001
8603.0063	1609.5	0.0016	8603.0091	1609.5	0.0044
8603.9812	1613	0.0024	8603.9819	1613	0.0031
8606.9049	1623.5	0.0039	8606.9042	1623.5	0.0032
8607.0386	1624	-0.0016	8607.0392	1624	-0.0010
8920.9686	2752	0.0001	8920.9689	2752	0.0004
8921.1071	2752.5	-0.0005	8921.1050	2752.5	-0.0026
8923.0538	2759.5	-0.0020	8923.0532	2759.5	-0.0026
8927.9264	2777	0.0003	8927.9264	2777	0.0003
8928.0644	2777.5	-0.0009	8928.0646	2777.5	-0.0007
8929.0411	2781	0.0018	8929.0395	2781	0.0002
8929.1750	2781.5	-0.0035	8929.1758	2781.5	-0.0027
8949.9108	2856	-0.0014	8949.9104	2856	-0.0018
8950.0474	2856.5	-0.0040	8950.0483	2856.5	-0.0031
9284.1569	4057	0.0000	9284.1567	4057	-0.0002
9284.0163	4056.5	-0.0014	9284.0176	4056.5	-0.0001
9284.9912	4060	-0.0008	9284.9915	4060	-0.0003
9292.9246	4088.5	0.0011	9292.9225	4088.5	-0.0010
9293.0633	4089	0.0007	9293.0626	4089	-0.0000
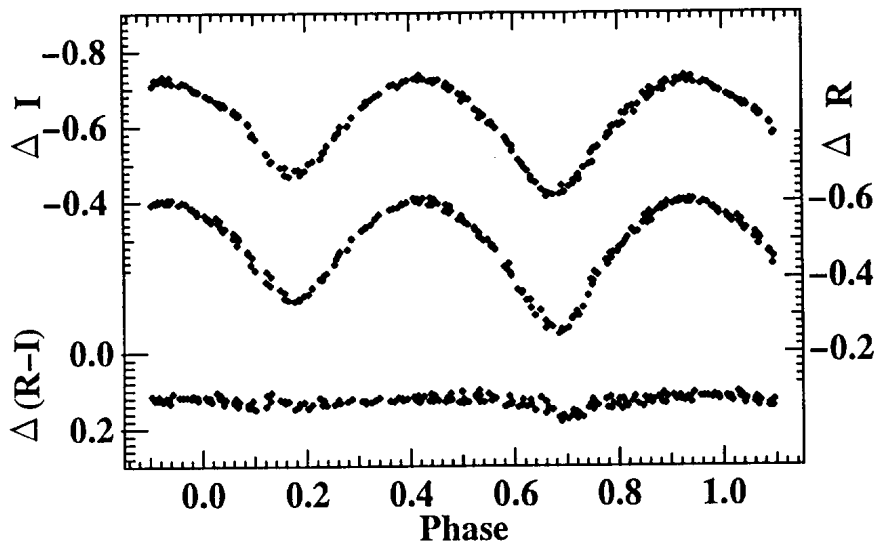
Figure 1. Light and color curves of VW Cep.
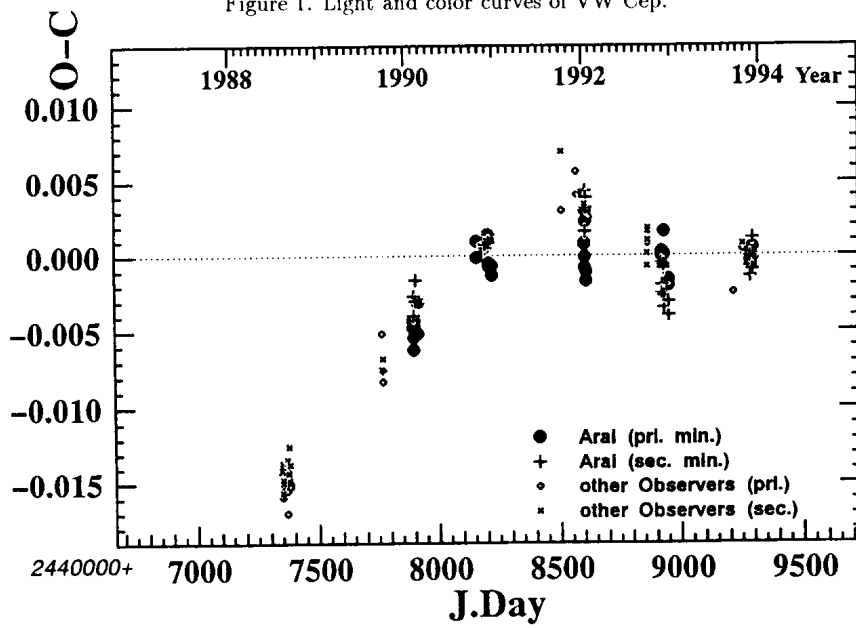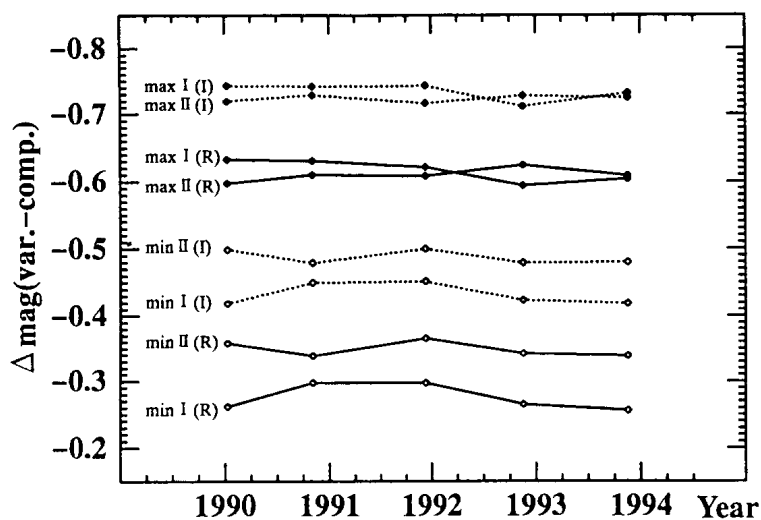
Figure 2. O–C diagram of VW Cep.

Figure 3. Variations of maxima and minima of VW Cep.

I would like to express my hearty thanks to Prof. M. Kitamura and Dr. A. Okazaki for valuable suggestions and encouragement.

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V397 Per IS MOST PROBABLY NOT VARIABLE

V397 Per is the fainter component of the double star ADS 2859. The partner is X Persei which is 6 magnitudes brighter than V397 Per, situated at an angular distance of only 22 arcsec, and itself variable. Traditional photometric techniques, be it photography, photoelectric aperture photometry or visual estimates can thus be used for V397 Per under great difficulties only. In GCVS (1987) the star is said to vary between 11.67 and 12.40 mag in V, i.e. by 0.73 mag. It is classified as "Lb:", but apparently this classification is based on just a few measurements, made with very different instruments (see Haupt and Moffat, 1973). The SIMBAD database does not contain any information on the star.

These are the reasons why we started observing the object with an "ST6" CCD camera mounted to an 8-inch Schmidt-Cassegrain telescope at Marl, Germany. No filters were used. The CCD covers a broad optical wavelength band, ranging from about 4000 to 9000 Angstroms. From November 1992 to April 1994 a total of 179 images were taken, usually in groups of 3, with exposure times of 10, 30 and 60 seconds respectively. Two neighbouring 12th-magnitude stars were used as reference, and six fainter ones were used as check. The 10 second exposures gave smallest scatter, probably due to the minimization of image overlap with X Persei.

Over the 1.5 year observing period V397 Per showed no brightness variations beyond the uncertainty of our measurements. The rms scatter of the 62 10-second measurements is 0.053 mag. Subtracting the estimated measurement errors one finds that the rms scatter of the true magnitudes of V397 Per is smaller than 0.04 mag over the observing period. This is very small compared to the range of 0.73 mag given in GCVS.
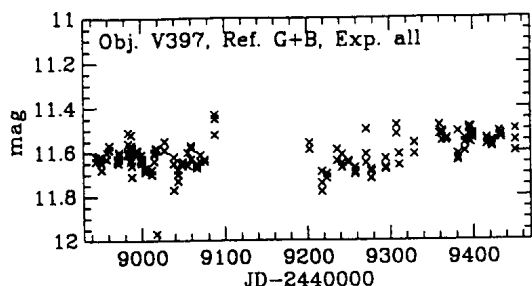

Figure 1: CCD light curve of V397 Per.
All 179 measurements are shown. Magnitudes are given with an arbitrary zero point, defined by the GSC magnitudes of a few surrounding stars. The rms scatter of the points around their mean value is 0.068 mag. Three nights are somewhat affected by cirrus (JD 2449018, 2449088 and 2449271). On JD 2448988 a long series of exposures was taken to exclude rapid variations.
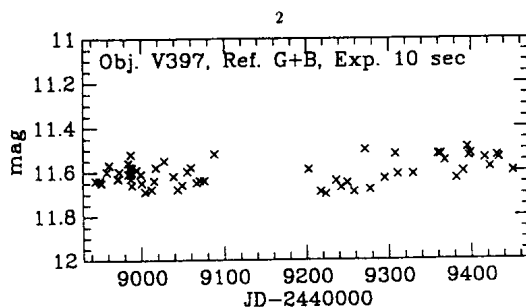
Figure 2: CCD light curve of V397 Per.
Only the 62 10-sec exposures are shown. The rms scatter of the points around their
mean value is 0.053 mag. This implies an rms variation of the star of less than 0.04 mag.

There are two statistically significant indications of variability in the light curves shown
in Figures 1 and 2. The first is an increase of the mean brightness after JD 2449360 by
about 0.07 mag. This increase is significant at the 6 sigma level in Fig. 1, and at the
5 sigma level in Fig. 2. But it nicely coincides with an increase in the mean brightness
of X Per, as derived from the online database of visual observations of the Association
Francaise des Observateurs d'Etoiles Variables (AFOEV) at Strasbourg. Thus we regard
it as due to a very small image overlap with X Per.

Second, an autocorrelation analysis of the data showed a periodicity with approxi-
mately 30 ±3 days. It is marginally significant at the 0.1 percent level (it is vaguely
visible to the eye in the left part of Fig. 1). The corresponding sinusoidal amplitude
would be of the order of 0.03 mag. However, direct light curve fitting and period search
did not give positive results. This means that any oscillations of the star, if real, could
not be coherent over the 1.5 years time span.

Our observations clearly exclude variability with an amplitude of the order of 0.7
magnitudes. There is a remote possibility that we caught a particularly quiescent phase
of an Lb type variable. But it is much more likely that the variability reported by Haupt
and Moffat (1973) and in GCVS is spurious, i.e. due to image overlap with close-by bright
X Per. We suggest that V397 Per be classified as constant. Occasional checks on the star
over the next few years will be used to strengthen this conclusion.

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Reference:
Haupt, W., Moffat, A., 1973, *Astrophys. Lett.*, **13**, 77

UBVR PHOTOMETRY OF THE ECLIPSING
BINARY FH ORIONIS

The close binary system FH Ori (=47.1929=HD 243229, m=10.5−11.5pg, Sp.:A2) was detected by Hoffmeister (1929) as an eclipsing variable. The binary has been observed only by visual and photographic methods, while the visual estimations were overwhelming. Studying the times of minima Szczepanowska (1955) concluded that the variations of period seemed to be regular and could be represented by a curve having a period of about 18 years and an amplitude of $0^{d}025$.

According to he GCVS the ephemeris of FH Ori is

$$\text{Min I} = \text{HJD } 2425900.387 + 2^{d}15116 \times E.$$

Soloviev (1947) observed the variable and found no constant brightness in the primary minimum (d=0), but the value d>0 in the curves obtained both by Kordilewski and Szczepanowska (1955).

We carried out the observations of FH Ori with the 0.6 m telescope at Mt. Maidanak in 1989/93 and 137 in U and 243 points were obtained in each B, V, R band. BD+4°911 (V=$10^{m}13$; U−B=$0^{m}12$; B−V=$0^{m}42$; V−R=$0^{m}26$) and BD+4°913 (V=$11^{m}26$; U−B=$0^{m}20$; B−V=$0^{m}21$; V−R=$0^{m}20$) served as comparison and check stars, respectively. Having used the above ephemeris we calculated the shift of the normal primary minimum to $0^{P}9049$. The O−C residuals are plotted in Figure 1. We also used the list of the minima from Szczepanowska's (1955) report. A long gap between the last observations of the binary does not permit to see a character of the period change. In order to get a zero shift for the most recent primary minimum, we suggest that the new period is equal to $2^{d}15114089$. Photoelectric curves of FH Ori are drawn in Figure 2. We can see a deep primary minimum and a hardly visible secondary one. The eclipse duration at the primary minimum is $0^{P}20$ and d is equal to zero exactly. We list the main parameters of the curves of FH Ori in Table 1.

Table 1

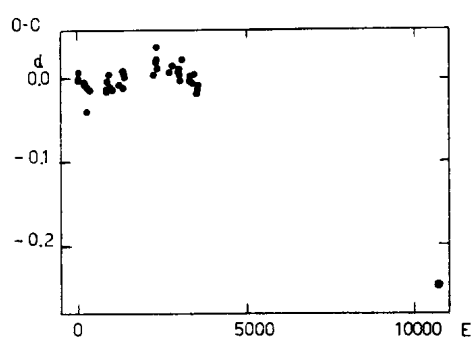|	V	U−B	B−V	V−R
Max	11.26	0.21	0.20	0.20
Min I	12.41	0.21	0.28	0.28
Min II	11.27	–	0.19	0.14

Figure 1. O−C diagram for FH Ori.

Figure 2. The light curves of FH Ori.

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References:

Hoffmeister, C., 1929, *Astron. Nachr.*, **236**, No. 5655, 233
Soloviev, A. V., 1947, *Astron. Circ.*, No. 63, 12
Szczepanowska, A., 1955, *Acta Astron. Ser. B* , **2**, 134

NEW PHOTOELECTRIC OBSERVATIONS
AND PERIOD OF RS LEPORIS

The first photoelectric observations of the eclipsing system RS Lep (BD$-20°1245$) were made by Wood (1959). Over the years, Klepczynski and Wood (1964) determined the improved light elements by means of the available published minimum times. The present observations were carried out with the single channel photoelectric photometer in BV bands at Yunnan Observatory. The 60cm reflecting telescope was employed on three nights in December 1993 and the 100cm reflecting telescope was employed on the three nights in February 1994. The star BD$-20°1244$ and the star BD$-20°1253$ were used as the comparison star and check star, respectively. From our observations 286 points in B and 290 points in V shown in Figures 1 and 2 were obtained. From these data moments of two primary minima were determined which are included in Table 1.

The new observations show a different amplitude for the primary minimum from that determined by the previous observer, the present depths of primary minimum are about 1^m7 in B band and about 1^m6 in V band, while those of the previous observer are about 1^m6 in B band and about 1^m4 in V band. All available minimum times were introduced into a least squares solution to derive the new light elements:

$$\text{Min. I} = \text{JD(Hel.)} 2427386.5282 + 1^d28854391 \times E$$
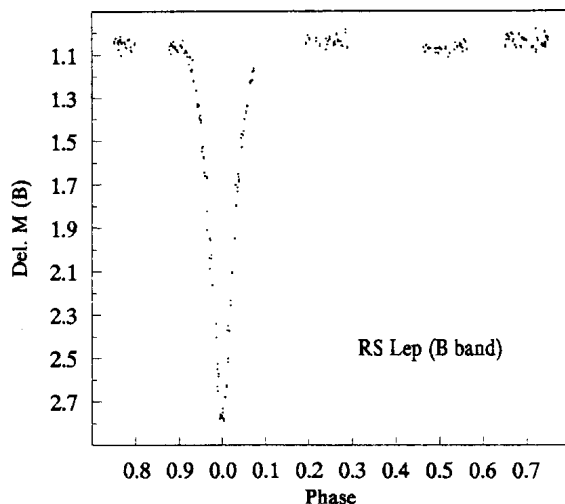$$\pm 22 \qquad \pm 19$$
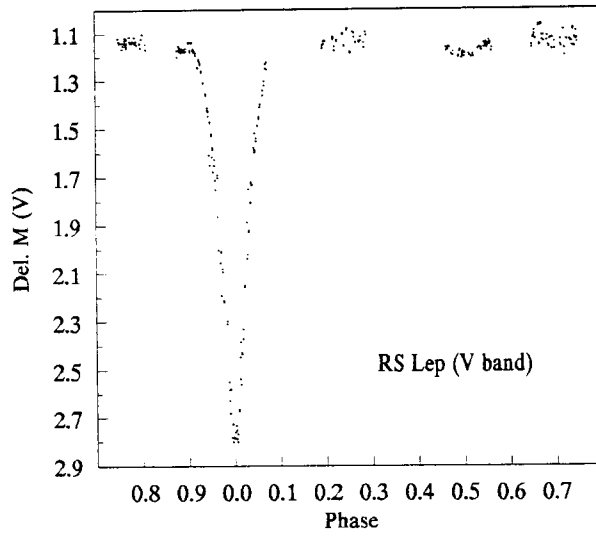

Figure 1. The blue individual observations of RS Lep.
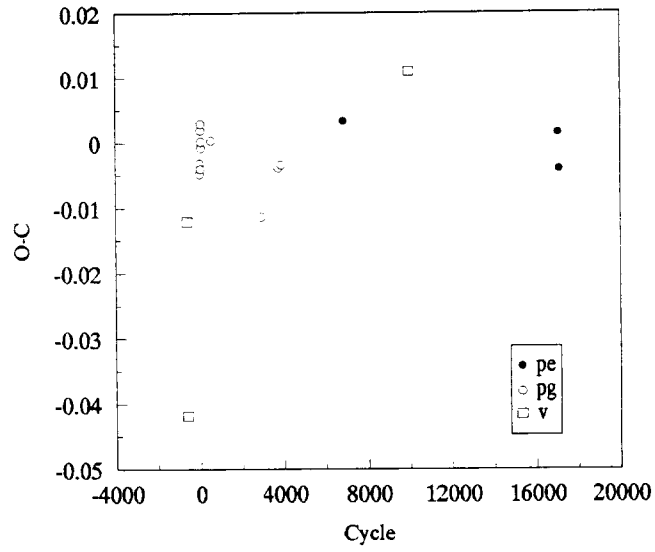
Figure 2. The yellow individual observations of RS Lep.

Figure 3. The O−C diagram.

Table 1. Minimum times of RS Lep

JD.(Hel.)	Cycle	O−C	Weight	Source
2426596.6090	−613	−0.0418	1	S
2426604.3700	−607	−0.0121	1	Z
2427386.5250	0	−0.0032	3	S
2427390.3890	3	−0.0048	3	Z
2427438.0660	40	−0.0040	3	S
2427443.2260	44	0.0019	3	S
2427443.2270	44	0.0029	3	Z
2427461.2630	58	−0.0008	3	S
2427461.2640	58	0.0002	3	Z
2428091.3620	547	0.0003	3	G
2431163.2390	2931	−0.0114	3	Z
2432235.3150	3763	−0.0039	3	S
2432409.2690	3898	−0.0034	3	S
2436191.1520	6833	0.0033	30	W
2436204.0375	6843	0.0033	30	W
2440207.5510	9950	0.0109	1	F
2449334.2981	17033	0.0015	30	This paper
2449396.1426	17081	−0.0041	30	This paper

S=Soloviev, Z=Zessevich, G=Gaposchkin, W=Wood, F=Flin

In our calculation weight 1 was assigned to the visual minimum times, weight 3 to the photoelectric minimum times and weight 30 to the photoelectric ones.

Using this new formula we have calculated the O−C values listed in Table 1 and plotted the O−C diagram displayed in Figure 3. From the O−C diagram it is seen that the period of RS Lep does not vary. Further observations of the system will be made during the next observing season and the final analysis and discussion will be published elsewhere.

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MWC147: A SUSPECT OF A PRE-MAIN SEQUENCE BINARY STAR

MWC147 (HD 259431, SAO95823, $\alpha_{1950.0} = 6^h30^m19\overset{s}{.}37$ $\delta_{1950.0} = 10°21'38\overset{''}{.}2$) is embedded in the nebulosity of NGC 2247 and is a probable member of the Monoceros R1 association (Halbedel 1989). It is classified as a B6pe star (Finkenzeller and Mundt, 1984), and has a visual magnitude of V = 8.7 (Terra-Negra *et al.*, 1994).

Being classified as a Herbig Ae/Be star, MWC147 has been observed since 1992 in a systematic survey that is being conducted at the Astrophysical National Laboratory (LNA - Brazil), aiming at investigating the properties of these stars. The spectra were obtained using the Coudé focus in the 1.6 m (LNA, Brazil, 0.12 Å/pixel), and in one mission, the 1.4 m CAT (ESO, Chile) was used. MWC147 was observed in the visible region of the spectrum (Hα) and showed a double peak emission profile (Fig. 1).

It is clearly seen that the emission Hα profiles show a transit. This behavior might suggest that this star is a member of a binary system.
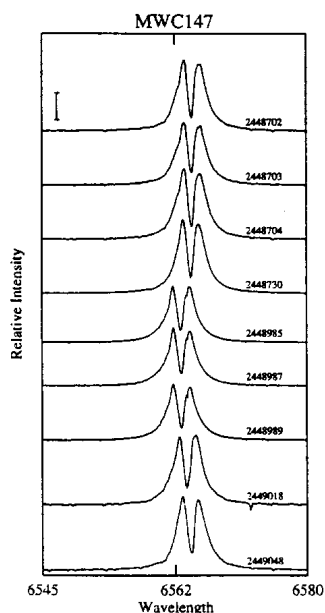

Figure 1. Spectra of MWC 147 showing the variation in the center of the Hα emission lines. The vertical bar (top and left) indicates five units in relative intensity, continuum intensity for each spectrum is one. The Julian date of observations is indicated in each spectrum.
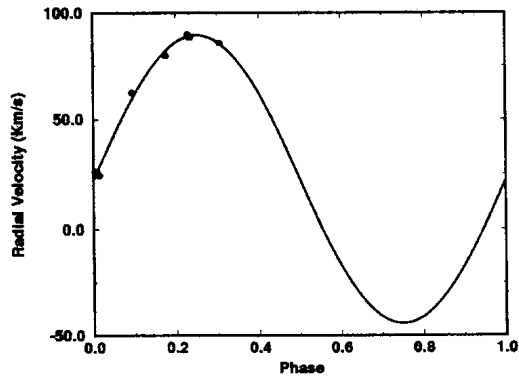
Figure 2. Radial velocity of MWC 147.

A preliminary analysis of the variations of the radial velocity, assuming a circular orbit (Fig. 2), give the following orbital parameters:

Period=365±3days
e=0
$\omega=-$
K=67±2 km/s
V_{CM}=23±2 km/s

These results are first approximation because of the small amount of the observed points (only 9), but the period found is in agreement with the transit showed by the spectral lines.

Further observations are needed in order to confirm the obtained orbital parameters.

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Terra-Negra, L., Chavarria-K, C., Diaz, S. & Gonzales-Patino, D.: 1994, *A&AS*, **104**, 557

IS GLIESE 410 OR BD+23° 2297 THE VARIABLE STAR?

The dM1 star, Gliese 410, was reported as a photometric variable star by Bopp et al. (1983). It apparently displayed V-band modulation with an amplitude of 0.1 magnitudes and a period of 2.935 days. Such a short period in a star with a deep convection zone is likely to give rise to magnetic activity in its outer atmosphere, leading to chromospheric and coronal emission. Subsequent spectroscopy has shown that Gliese 410 is mildly active. It has a chromospherically filled Hα line (although it is not in emission) and has modest emission lines at Ca II H and K (Panagi & Mathioudakis 1993). We have compared Gliese 410 with other dwarfs that have similar known periods and spectral types. Gliese 388 (AD Leo - P=2.7 days), Gliese 490A (BF CVn - P=3.17 days) and Gliese 803 (AU Mic - P=4.87 days). These all show Hα in emission, have other chromospheric lines that are up to an order of magnitude stronger than in Gliese 410, and are considered to be amongst the most active late-type stars in the solar neighbourhood. If Gliese 410 does have a 2.935 day period, then it is anomalously under-active.

Bopp et al. (1983) used the comparison star BD+23° 2297 in their investigation. The V and B-V magnitudes of this star are given as 8.70 ± 0.35 and 0.72 ± 0.13 by the *Hipparcos* Input Catalogue (Turon et al. 1992), in reasonable agreement with the spectral class of G5 (given in the SAO catalogue), if the star is a dwarf. This star lies within the error circle of a *ROSAT* Wide Field Camera (WFC) EUV source in the most recent WFC catalogue (Pye et al. 1994). The EUV source is designated 2RE J1101+223 in IAU nomenclature, and BD+23° 2297 has been positively identified as the optical counterpart, on the basis of chromospheric emission at Ca II H and K. A rough calculation of the EUV to bolometric luminosity yields a value of $\sim 2 \times 10^{-4}$, which is characteristic of the most magnetically active stars - usually young, rapid rotators or close binary systems (Jeffries et al. 1991). BD+23° 2297 is therefore very likely to show short-period photometric variability caused by starspots rotating across the visible surface, and may be the true source of the variability seen by Bopp et al. (1983).

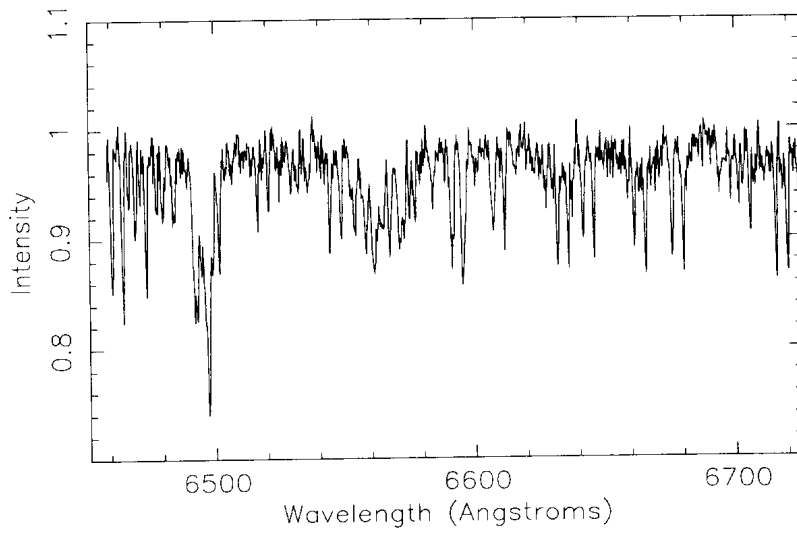BD+23° 2297 has been observed spectroscopically at the 2.5 m Isaac Newton
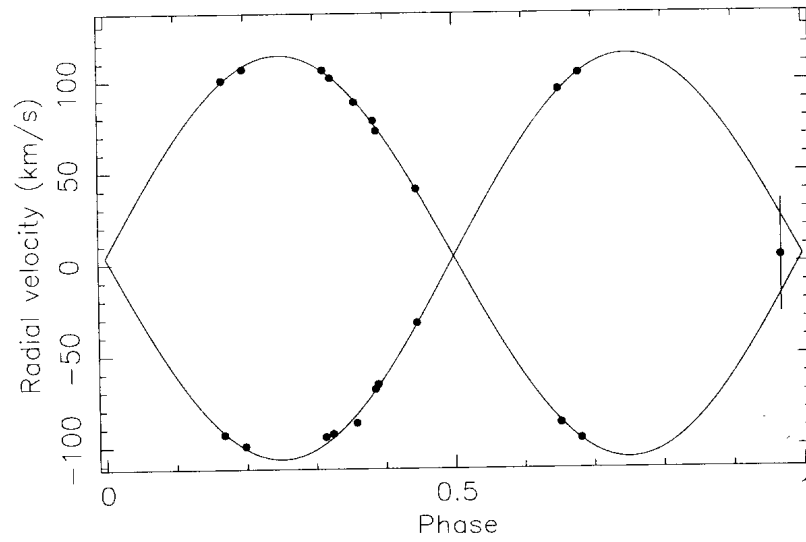
Figure 1: A spectrum of BD+23° 2297 in the Hα region.

Figure 2: The radial velocity curve folded with the ephemeris HJD 2449055.132+1.528E. Errors are generally smaller than $2\,\mathrm{km\,s^{-1}}$.

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Telescope, with an intermediate dispersion spectrograph and a CCD camera. The spectra obtained were in the red and had a resolution of 0.44Å. BD+23° 2297 is clearly a short-period, double-lined spectroscopic binary and has a Hα feature that appears to be chromospherically filled in (see Figure 1). Analysis of a radial velocity curve taken over 6 nights (Figure 2) yields the following orbital elements. Period = (1.528 ± 0.006) days, $K1 = K2 = (110 \pm 2)$ km s^{-1}, $\gamma = 3.9 \pm 2.3$ km s^{-1} and zero eccentricity. If the stars are tidally locked, as they usually are in short-period systems, then starspot modulation with the orbital period might be expected. A consideration of the frequencies involved quickly reveals that aliases with a one day period would produce a signal at a period of 2.89 ± 0.02 days, very close to the period obtained by Bopp et al. (1983). Bopp et al. do not present their raw data, so we cannot make a detailed examination of this hypothesis. Nevertheless, the aliased period is sufficiently close that spot migration or differential rotation could explain the remaining discrepancy.

In summary, we have found that BD+23° 2297, a star used as a comparison to derive the rotation period of Gliese 410, is likely to be variable itself. If Gliese 410 *is* the true variable, it is decidedly under-active for its rotation rate. BD+23° 2297 is a short-period SB2, and the orbital period aliased with a 1 day^{-1} frequency could produce the modulation period found for Gliese 410. Further photometry of both stars is needed to resolve the issue.

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CZ Cnc – A DWARF M FLARE STAR

Lovas (1977) discovered an apparent 13.5 mag stellar object on a blue Schmidt plate taken in 1976. A subsequent Schmidt plate showed the object at 18.0 mag implying a decline by 4.5 mag in 80 min. On the Palomar Sky Survey plates only the red exposure shows a star at the position of CZ Cnc near the detection limit.

Schaefer (1990) obtained multicolor photometry of this faint red object: V=21.15, B-V=1.86, V–R=1.39, V–I=3.86, V–J=5.98, V–H=6.59 and V–K=6.92. He interpreted this object as a very low luminosity main-sequence star and derived M_V=16.1 and a distance of 100 pc.

We have observed CZ Cnc with the CARELEC spectrograph at the 1.93 m telescope of the Observatoire de Haute-Provence (OHP, France). Low resolution spectra were acquired using a TK 512 CCD chip. We obtained two 30 min. long exposures on 1992 February 4.01 and 11.03 UT. Owing to its faintness and red colour, the star was only detected longwards of 6400 Å with a rather high noise level. The summed observation smoothed with a gaussian filter of $\sigma = 30$ Å is shown in Fig. 1. For comparison we plot the spectrum of the dM3-5e flare star located in the error box of the 1978 October 6B γ-ray burst which had suffered a flare of $\Delta m_B \approx 5.2$ mag (Greiner & Motch, 1994). The large TiO molecular bands are clearly seen in CZ Cnc and suggest a late M type star in agreement with the photometric colour indexes reported by Schaefer (1990). An accurate spectral classification would necessitate deeper observations at longer wavelengths.
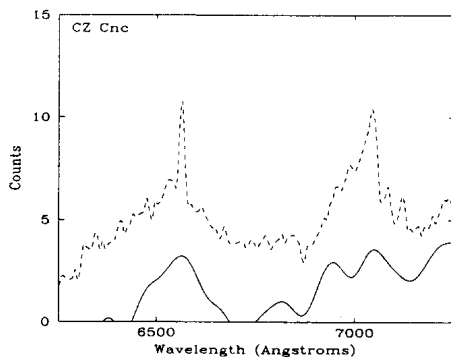

Figure 1: Mean red spectrum of CZ Cnc smoothed with a gaussian filter of $\sigma = 30$Å (solid line). For comparison we show the spectrum of the dM3-5e flare star located in the error box of the 1978 October 6B γ-ray burst (dashed line) as measured with the same instrumentation. The large TiO molecular bands are clearly visible and classify the object as a late M star.
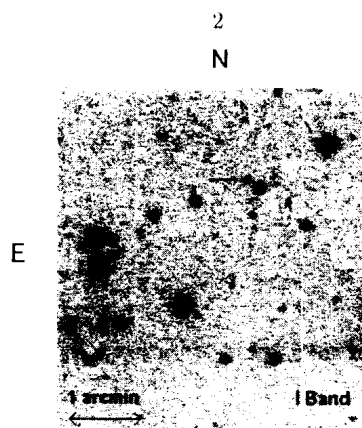
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Figure 2: A finding chart showing the position of CZ Cnc on a 10 min. long I band CCD exposure.

In addition to the position determination of Kholopov et al. (1985) which corrected for the equinox error in Lovas (1977) we give in Fig. 2 a more detailed finding chart based on a 10 min I band CCD exposure taken on 1992 January 31.09 UT with the 1.2 m telescope at OHP.

Glaubitz (1992) has searched most of the available plates of Sonneberg Observatory archive (a total of 1092 taken between 1941 and 1991). The majority of these plates had a limiting magnitude of 14 mag (pg), and no further eruption was discovered.

The herewith presented evidence for CZ Cnc to be a dM flare star makes it the record holder in flare amplitude: 9.5 mag in blue. This is certainly only a lower limit (Greiner & Wenzel 1992) since 1) the exposure time of the plate (15 min.; Szeidl 1990) could have been longer than the time of CZ Cnc spent at maximum light, and 2) the discovery plate may not have covered the maximum of the flare.

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OPTICAL VARIABILITY IN SAO 20517 AND ITS
POSSIBLE IDENTIFICATION AS AN X-RAY SOURCE

During a recent campaign to observe the massive eclipsing binary system HD 219634 the field star SAO 20517 ($\alpha_{(2000)}$=23^{h}15^{m}30^s, $\delta_{(2000)}$=61°52') was used as one of 3 comparison stars. These observations reveal that SAO 20517 is variable with a variation of about 0.06 mag in the V passband. Figure 1 illustrates the photometric variation with respect to SAO 20532 during a two month period from July 1994 through August 1994. Figure 2 shows the same data phased with a period of 15^d.864. The star SAO 20532 ($\alpha_{(2000)}$=23^{h}16^{m}48^s, $\delta_{(2000)}$=61°48') has been used as the principal comparison star and SAO 20526 ($\alpha_{(2000)}$=23^{h}16^{m}42^s, $\delta_{(2000)}$=61°41') as a check star in these observations. Data have thus far been obtained using The King's University College Observatory CCD photometer on a 0.2 m telescope and the University of Alberta, Devon Observatory two-channel photometer attached to the 0.5 m telescope. The data, as presented have not been transformed to the standard UBV system.

SAO 20517 may be an x-ray source. It can be tentatively identified with the final source listed by Helfand and Caillault (1982), and coincides with a weak, unresolved source on plate 7-434 of "The Eistein Observatory Catalog of IPC X-Ray Sources". Bidelman (1994, private communicatio) suggests a spectral type of K0IV based on examination of a contaminated spectrum on an objective prism plate. This, and the light curve shown in Figure 2 lead us to suggest that SAO 20517 is either an RS CVn or ellipsoidal binary system. The relatively high incidence of transient x-ray source at high galactic latitude (Garcia et al., 1980) lends credence to the suggestion that SAO 20517 is an RS CVn
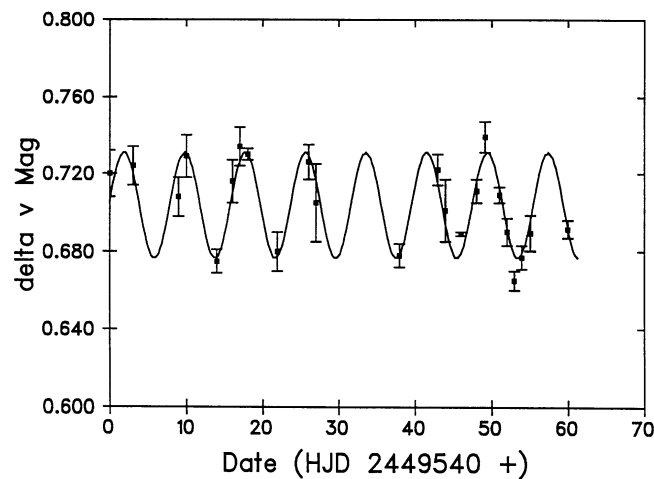

Figure 1.
V filter light curve for SAO 20517 covering a two month span. The solid curve represents a simple sinusoidal fit to data. Observations made on TKUC CCD and 0.2m reflector.
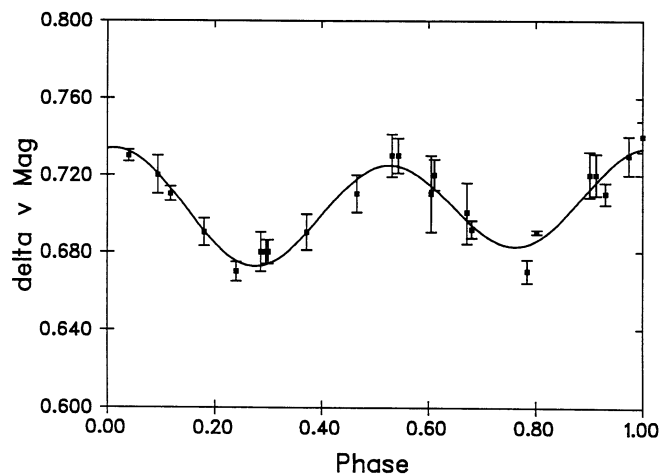
Figure 2. Light curve of observation shown in Figure 1 phased with a period of 15.864 days. Solid line shows the fit provided by the sum of the first four Fourier components.

system. At the same time evidence of ellipsoidal variation is provided by a least-squares fit of the first 4 Fourier components to the light curve. The variation can be described via:

$$\Delta v = 0.7045 - 0.0043\sin(\theta) + 0.0064\sin(2\theta) + 0.0064\cos(\theta) + 0.0251\cos(2\theta)$$

when Δv is represented as a function of phase (θ). The standard error in the Fourier coefficients is on the order of 0.002 mag. The residual error in the Fourier fit is approximately 0.007 mag which is typical of the scatter in the observations. The dominance of the $\cos(2\theta)$ term supports the suggestion that SAO 20517 is an ellipsoidal binary system.

The authors are obtaining additional multicolour (UBVR) photometric data. Spectroscopic data are being obtained Dominion Astrophysical Observatory, Victoria. A complete discussion of this system will be published elsewhere. We thank Dr. W. Bidelman for a very informative discussion about this star and related matters.

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MULTIPERIODIC PHOTOMETRIC VARIATIONS OF HD 210111
AND SUSPECTED VARIABILITY OF HD 210049

We present time series of our observations of a new variable λ Boo star, HD 210111 (m_V = 6.4), which is classified as kA2hA7mA2V λ Boo by Gray and Corbally (1993). λ Bootis stars are a group of metal poor Population I stars (Weiss et al. 1994) with broad and often shallow hydrogen lines, which are probably caused by a gas shell. There are indications for such a gas shell also for HD 210111 (Stürenburg 1993). An abundance analysis for that star (Stürenburg 1993) gave a metal deficiency of about a factor of 10 compared to the Sun.

Our observations were part of a survey for pulsation among λ Boo stars (Paunzen, Weiss and North 1994, Kuschnig, Paunzen and Weiss 1994a,b), using the 70 cm Swiss-telescope at ESO, La Silla with the Geneva photometer. When variability of HD 210111 became evident in the raw data, it was decided to observe this λ Boo type star as frequently as possible. PN and EP used HD 210049 (m_V = 4.5, A1 IVnn) as first comparison star during 8 nights distributed over 2 weeks, and in addition in one of these nights HD 210302 (m_V = 4.9, F6 V) as a second comparison.

HD 210111: A quick look at the extinction corrected differential instrumental magnitudes (Fig. 1) indicates already multiperiodic variations for this star. An amplitude spectrum computed with a single-frequency Fourier technique for unequally spaced data (program PERIOD, Breger 1990) indicates the presence of at least 2 pulsation frequencies (Fig. 2, second panel). The frequencies with the largest amplitudes are f_1 = 27.99 c/d and f_2 = 17.01 c/d, which could be influenced by a 1 c/d aliasing. In any case, this solution is rather formal and serves only as a guideline for the relevant frequency range.

A simultaneous 4-frequency fit to the observations of HD 210111, based on the lowest residuals after a step-by-step prewhitening, results in a scatter of 4.0 mmag, which is almost twice the value for the extinction corrected observations of the comparison star HD 210049. We thus conclude that probably several modes may be excited in HD 210111. A problem for the frequency analysis is the poor duty cycle of only 7% of our single-site data. However, it is quite obvious that HD 210111 is a promising candidate for an international photometric observing campaign.

The calibration (Crawford 1979, Philip & Relyea 1979, for [Fe/H] = −1) of $uvby\beta$ photometry applied to the indices listed by Hauck & Mermilliod (1990) for HD 210111 results in M_v = 1.65, T_{eff} = 7900 K, and $\log g$ = 3.95. These parameters give Q-values ranging from 0.014 to 0.022 d, based on

$$\log Q = -6.456 + \log T_{eff} + 0.5 \log g + 0.1 M_{bol} + \log P$$

According to pulsation models (Fitch 1981), such Q-values indicate pulsation in the second to fifth overtone.

HD 210049: Our present analysis depends on the constancy of the primary comparison, HD 210049, except for one night, where a second comparison star has been observed.
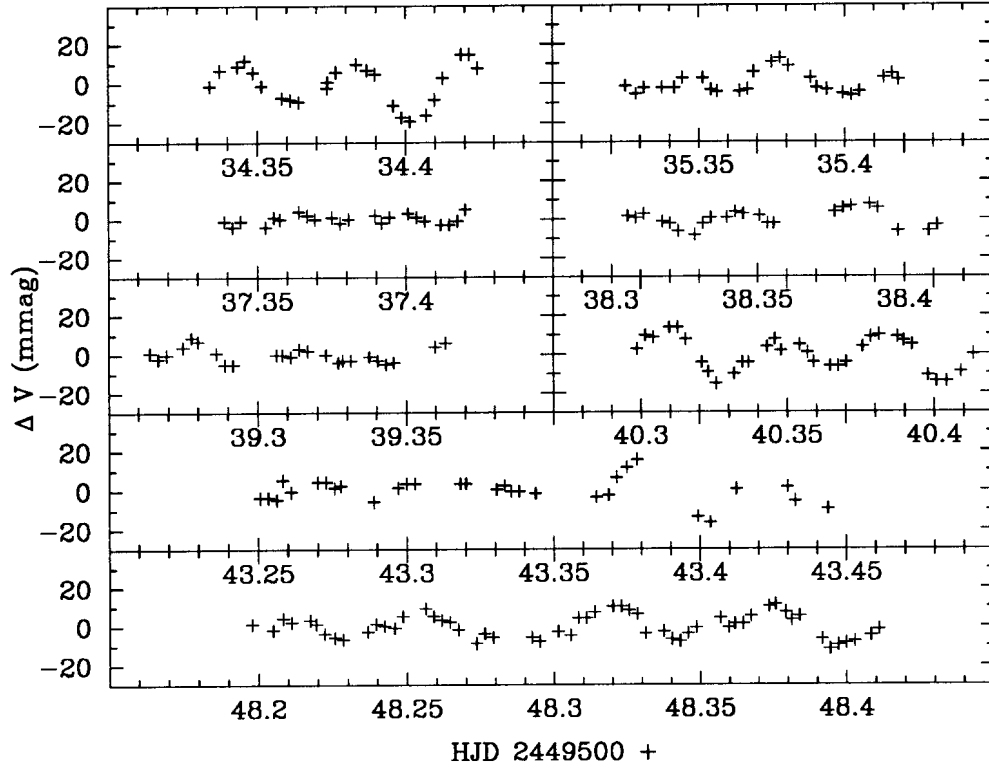
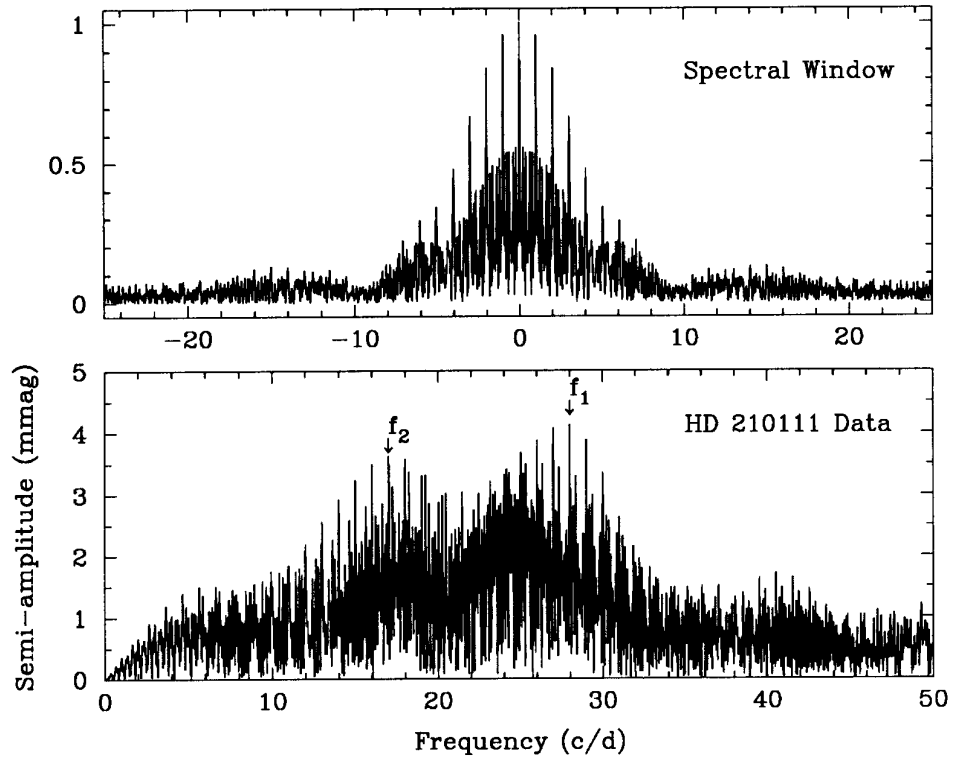Figure 1. HD 210111–HD 210049 in Geneva-V, residuals to night-mean

Figure 2. Amplitude spectrum (bottom panel) and spectral window of the data of Fig. 1
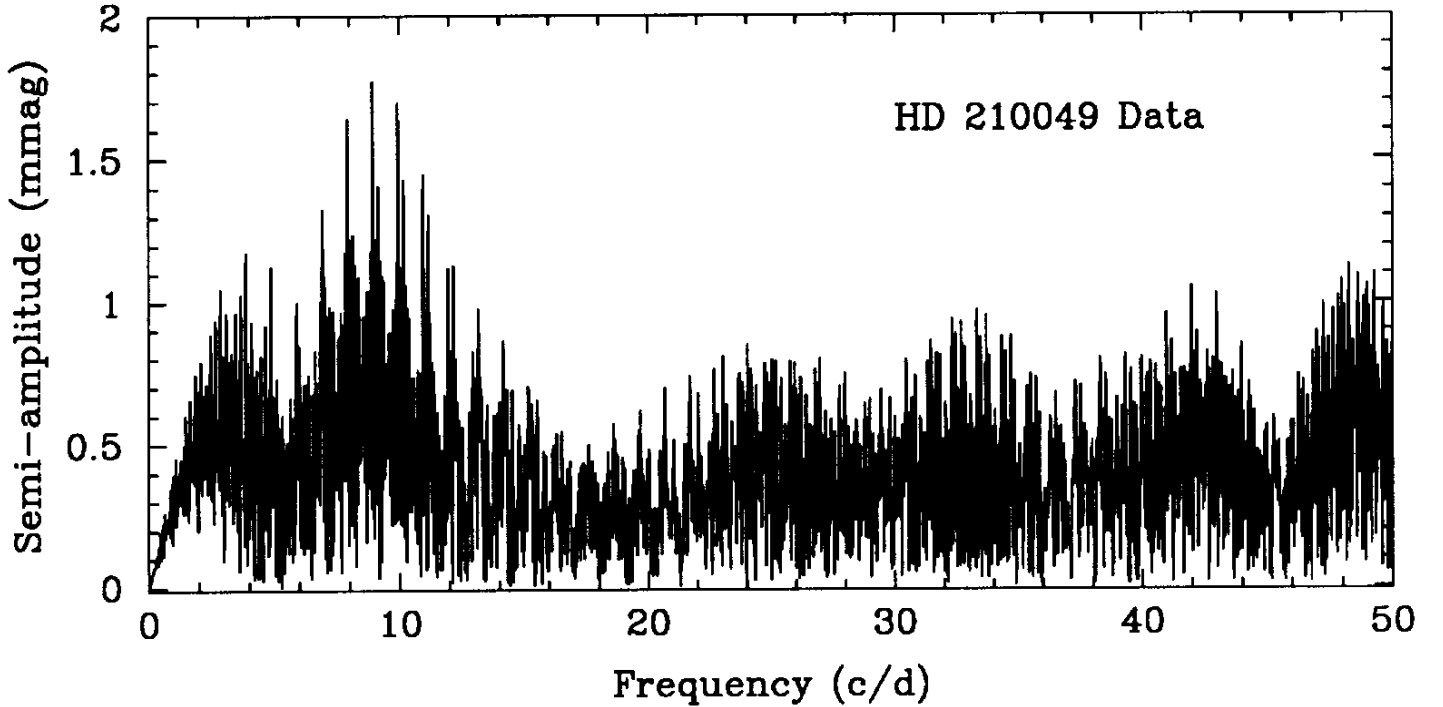
Figure 3. Amplitude spectrum of the extinction corrected Geneva-V photometry
of HD 210049

In order to demonstrate the validity of this assumption we show the amplitude spectrum
of our extinction corrected instrumental data of HD 210049 in Fig. 3. The highest noise
peaks for frequencies larger than 15 c/d show amplitudes of 0.7 mmag. However, a peak
at 8.9 c/d with an amplitude of 1.7 mmag clearly exceeds the noise level. This peak also
appears in the amplitude spectrum of the *differential* HD 210111 – HD 210049 data, but
not in the HD 210111 data alone. The differential magnitudes of the two comparison stars
HD 210049 – HD 210302 have σ=2.0 mmag.

We therefore cannot exclude variability of our primary comparison star, HD 210049,
with a period of about 2.7 hours, but cannot proof this claim with the second comparison
star. However, it is quite safe to attribute the variability in the differential photometry
of our λ Boo star in the 15 to 30 c/d frequency domain (Figs. 1 and 2) to HD 210111, and
not to the comparison star.

Pulsation of HD 210049 would be remarkable, because effective temperature and abso-
lute magnitude ($T_{eff} = 9000$ K, $M_v = 0.9$), based on Strömgren photometry, locate this
star outside the δ Scuti instability strip. On the other hand, the hot border of this insta-
bility strip is not very well defined and a shift towards hotter temperatures was recently
proposed by Rodriguez et al. (1994).

Conclusions: We discovered multi-periodic variability in the λ Boo star HD 210111
and cannot rule out variability of HD 210049. The frequency spectrum of HD 210111 is
complicated and only a sufficiently long multi-site campaign (3 weeks or more) will allow
a successful resolution. HD 210111 is a promising candidate for applying asteroseismic
techniques and thus to investigate the problem of the origin of λ Bootis stars. Another
interesting case is HD 111786 (Kuschnig et al. 1994a). We also encourage further obser-
vations of HD 210049.

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Philip A. G. D., Relyea L. J., 1979, *AJ*, **84**, 1743
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Stürenburg S., 1993, *A&A*, **277**, 139
Weiss, W. W., Paunzen, E., Kuschnig, R., Schneider, H., 1994, *A&A*, **281**, 797

A NEW Be PHASE OF PLEIONE

The well known Be-shell star Pleione (BU Tauri, HD 23862, B7-8IV-Ve, vsini=320 km/s) passed through several B, Be and Be-shell phases since 1888. The last Be-shell phase began in 1972 (Delplace and Hubert, 1973; Hirata and Kogure, 1976), reached a maximum around 1982 and entered a decrease in 1984 (Ballereau et al., 1988). In 1987-88, emission lines were strong, shell lines almost completely disappeared (with the exception of FeII multiplet No. 42), while the photospheric component of Balmer lines, weak and shallow in 1982, became deeper and wider (Ballereau et al., 1994). The disappearance of the shell lines goes along with the increase of their negative RVs (higher terms of the Balmer lines and metallic ions), which indicates that the surrounding envelope of gas gradually expands in space over several years. Recent observations of Hα emission component made by Menchenkova and Luthardt (1993) confirm the gradual increase of its equivalent width until 1991-92 and the faintness of the central reversal.

On Aug. 9, 1994, we obtained the Hβ and FeII λ4924Å line profiles of Pleione, with the AURELIE receptor attached to the coudé focus of the 1.52m telescope of Haute-Provence Observatory (Figure 1). The parameters of the spectrum are as follows:

Resolution=$\lambda/\Delta\lambda$=16400
Signal to noise ratio=S/N=200
Recorded spectral wavelength range=$\lambda\lambda$4806-4952Å

The spectroscopic parameters measured on the Hβ and FeII emission profiles (radial velocities (RV) in km/s, intensities (I) in fraction of stellar continuum intensity) give the following results:

Hβ

Violet peak: RV=−140, I=1.13; central reversal: −79, 1.09; red peak: +15, 1.44; V/R=0.78; emission peak separation, Δe=155 km/s. RV and total width of the emission line at the junction with the photospheric profile: −91, 617; at the intensity level 1.00: −53, 328; at the intensity level 1.10: −36, 254.

FeIIλ4924Å

Violet peak: RV=−220, I=1.02; central reversal: −86, 0.99; red peak: +28, 1.11; V/R=0.92; Δe=248km/s.

From comparison of the present data with those obtained these last years, several remarks can be emphasized:

1. The decrease and vanishing of shell lines on Balmer series and metallic ion spectra, simultaneously with the strengthening of the emission components observed since 1984 until the nineties are monotonic phenomena, which translate the gradual spatial development of the surrounding emitting/absorbing envelope of Pleione.
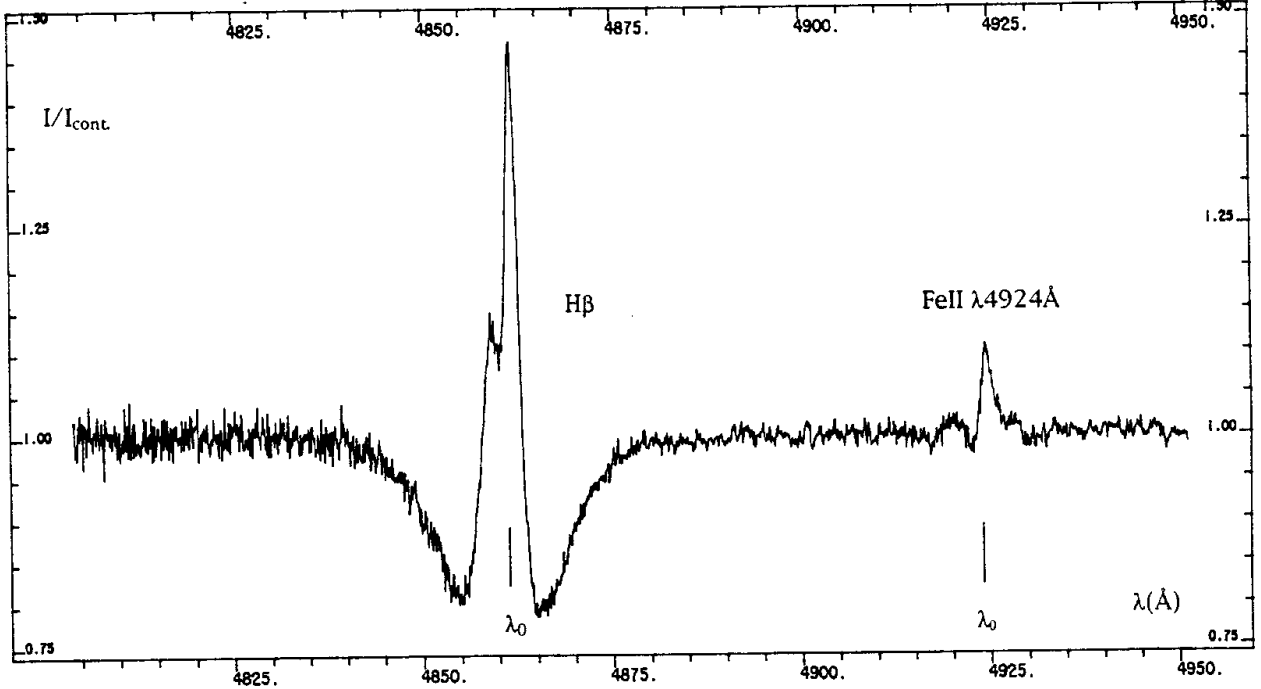
Figure 1. Normalized intensity tracing of the Hβ and FeIIλ4924Å
lines of Pleione, on Aug. 9, 1994. The vertical bars give the rest wavelengths
of each line.

2. The progressively negative RVs of emission/shell-absorption lines of the optical spec-
trum from 1984 indicate the onset of a new instability which leads to a gradual expansion
of the envelope, as well in the equatorial plane, then, as probably, vertically on both sides
of this plane. In 1994, the RVs of the absorption-like remaining depression in the Hβ
and FeII lines (Figure 1, respectively -79 and -86 km/s) suggest a rather rapid expan-
sion, while before 1984, during the "quiet and strong shell phase", they were small with
periodic variations (Ballereau et al., 1988).

3. Measurements of peak separation (Δe) on Hβ obtained by ourselves since the sev-
enties, and used in Huang's (1972) formula in the case of a Keplerian rotational mo-
tion in the envelope, permit to obtain the outer radius of the Hβ emitting envelope:
R(Hβ)/R$_\star$=2.0 (1973); 5.5 (1981); 10.0 (1987-88); 17.0 (1994). The 1992 Hα emission
profile of Menchenkova and Luthard (1993) has Δe=2.77Å, which gives R(H$_\alpha$)/R$_\star$=25.6.
All these data confirm the expanding movement of the envelope of Pleione.

4. The fading of the Balmer photospheric profiles during the "quiet and strong shell
phase", before 1984, and their gradual strengthening after, show that at first the envelope
is probably compact, cool and optically thick, while its spectrum dominates the one of
the underlying B8 star. It looks the one of an A-F star. The expansion of the envelope
on both sides of the equatorial plane makes the central star more visible, which can also
explain the reappearance of the Balmer photospheric spectrum of Pleione.

5. The equivalent width of the emission in the Hβ line increases progressively: W(Hβ)$_{em}$=
0.42Å(1981); 1.80Å(1987-88); 2.70Å(1994).

6. The peak separation of the FeII emission line in 1994 (248 km/s) gives an outer radius of the FeII emitting disc of 6.7 $R_\star$. This indicates that this disc is nearer to the stellar surface than the Hβ emitting disc, as generally observed in Be star envelopes.

7. All these changes in the structure of the Pleione shell claim in favour of the phase-change model proposed by Kogure (1989), where the envelope responsible for a shell phase should be a compact thin/thick disc-like one, which has to expand to transform itself into an extended spheroidal/doughnut shape to produce a spectrum characteristic of a Be phase. The same type of model was also proposed by Zorec and Briot (1991) to explain the photometric variations during the phase changes of Be stars.

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Ballereau, D., Chauville, J., Zorec, J., 1994, International Conference *"Circumstellar Matter 1994"* held at Edinburgh (Scotland), Aug. 29th-Sep. 2nd, 1994
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REVISED EPHEMERIS OF THE SYMBIOTIC BINARY AG Dra

AG Dra is one of the most intensively monitored symbiotic stars. Its light-curve (LC) has been studied photographically since 1890 by Robinson (1966). Until 1930, the continuum of AG Dra had displayed a quiescent stage, but afterwards several eruptions have been observed. From 1965, multicolour photoelectric observations were performed by many authors. The periodic wave-like variation in the optical continuum was observed during quiescent stages. It is largest at the ultraviolet bands, $\Delta U \sim \Delta u \approx 1\,\mathrm{mag}$, and becomes smaller with increasing wavelength; by comparison $\Delta B \approx 0.3$ and $\Delta V \approx 0.1$ (e.g. Kaler 1987, Meinunger 1979). Meinunger (1979) from his U data established for the first time a 554 day period with a U_{max} epoch at JD 2 438 900. Consistence of this period with the orbital period of the binary was confirmed by radial velocity variations of the cool component measured by Garcia & Kenyon (1988). In accord with the Garcia & Kenyon's solution of the spectroscopic orbit, the minima in the U band correspond to the spectroscopic conjunction with the cool component in front. Recent UBV photometry confirmed this periodic variation. The data were mostly collected in our campaign's papers (Hric et al. 1991, 1993, 1994, Skopal et al. 1992, 1995).

The aim of this contribution is to determine an ephemeris for the minima in the ultraviolet domain. On this account we constructed the U/u LC from all the available data in the literature. Differential values of magnitudes in u published by Kaler (1987) and Kaler et al. (1987) were shifted by 9.7 mag to be approximately consistent with the star's brightness in the U band. The LC is shown in Fig. 1. It covers the period from 1974 March to 1994 September with the nine minima in the quiescence. Their positions were determined by the least squares fitting of the second degree polynom to the data under consideration. Results are summarized in Table 1. The linear regression of the minima positions at the epochs 1, 2, 3, 6, 8, 9, 10, 11 gives their ephemeris as

$$JD(U_{\mathrm{min}}) = 2\,442\,514.4(\pm 11.3) + 552.4(\pm 2.2) \times E. \qquad (1)$$

The minimum at JD$\approx$2 442 577 was not used for determination of this ephemeris, because of its worse definition and a larger shift in its position with respect to the other minima. The maximum uncertainties $\Delta JD_0 = 11.3\,\mathrm{d}$ and $\Delta P = 2.2\,\mathrm{d}$ were determined according to relations $\Delta P = \Sigma E^{-1} \Delta \mathrm{Min}/n$ and $\Delta JD_0 = \Sigma \Delta \mathrm{Min}/n$, in which n is the number of the minima used. For the uncertainty in the position of the minimum under consideration, $\Delta \mathrm{Min}$, we adopted the corresponding $O - C$ value, because of assuming a constant orbital period and the $O - C$ values are larger than the uncertainties in the position of individual minima. The minima indicated photographically in the historical LC, for example at $\approx$2 432 050, $\approx$2 433 760 (Sharov 1960), $\approx$2 434 790 (Luthardt 1983), agree well with those predicted by the ephemeris (1).
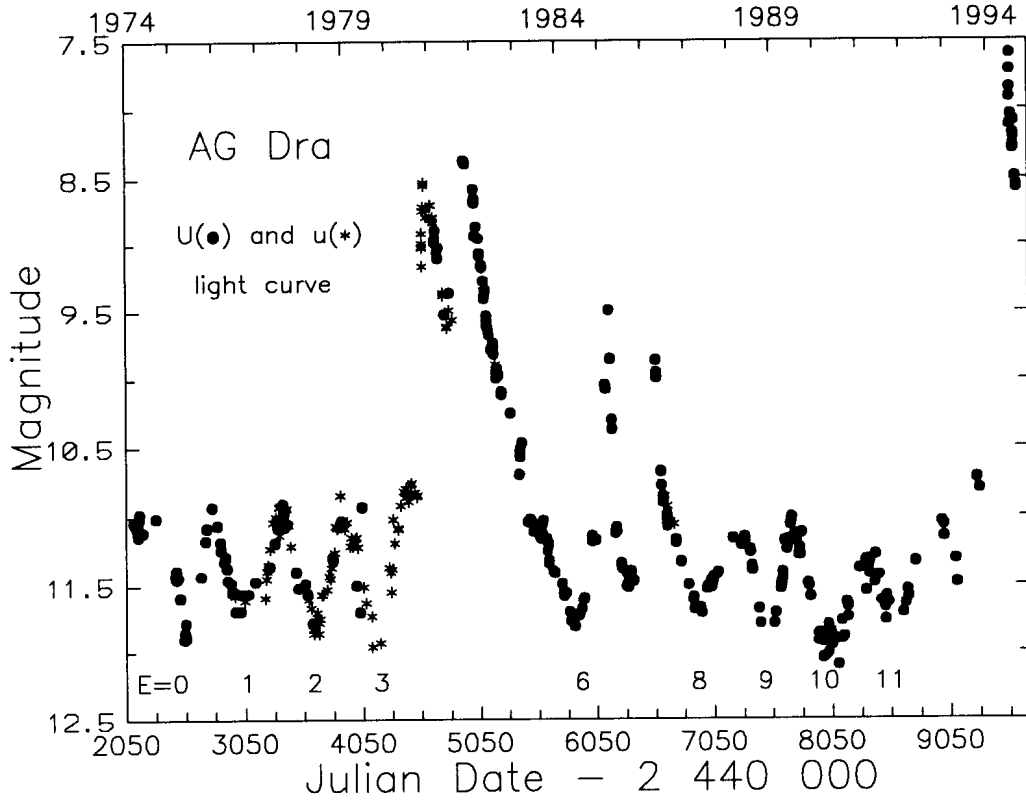
Figure 1. Compiled U/u light curve of AG Dra.

Table 1.

Epoch	$\mathrm{JD_{Min}}(O)$	$\mathrm{JD_{Min}}(C)$	$O - C$
0	$2\,442\,577.\ \pm 14.?$	$2\,442\,514.4$	62.6
1	$43\,064.8\ \pm 3.0$	$43\,066.8$	-2.0
2	$43\,622.4\ \pm 1.6$	$43\,619.2$	3.2
3	$44\,156.3\ \pm 3.6$	$44\,171.6$	-15.3
6	$45\,853.4\ \pm 2.0$	$45\,828.8$	24.6
8	$46\,920.4\ \pm 2.0$	$46\,933.6$	-13.2
9	$47\,503.8\ \pm 3.0$	$47\,486.0$	17.8
10	$48\,035.8\ \pm 3.0$	$48\,038.4$	-2.6
11	$48\,579.4\ \pm 3.0$	$48\,590.8$	-11.4

The $O - C$ diagram is shown in Fig. 2. Differences between the observed and computed positions of the minima are often far larger than the uncertainty of their determination. This reflects the fact that the individual minima differ from each other both in the shape and the position (cf. Fig. 1). Such behaviour cannot be ascribed to a reflection effect, because this effect can produce only a strictly regular shape of LCs. Moreover, due to a relatively small radius of the cool component ($< 50\,R_\odot$ as for its spectral type of <K4III), a very small fraction of the hot component radiation (approximately <0.4%, for the separation of the components of $400\,R_\odot$) will irradiate the facing cool component hemisphere, which is not sufficient to give rise of the 1 mag reflection effect (cf. Skopal 1994). It is suggested that the circumstellar matter located in the binary within the common potentials due to an outbursting activity of the hot component, is responsible for such a wave-like variation in the optical continuum (cf. Skopal et al., 1993).
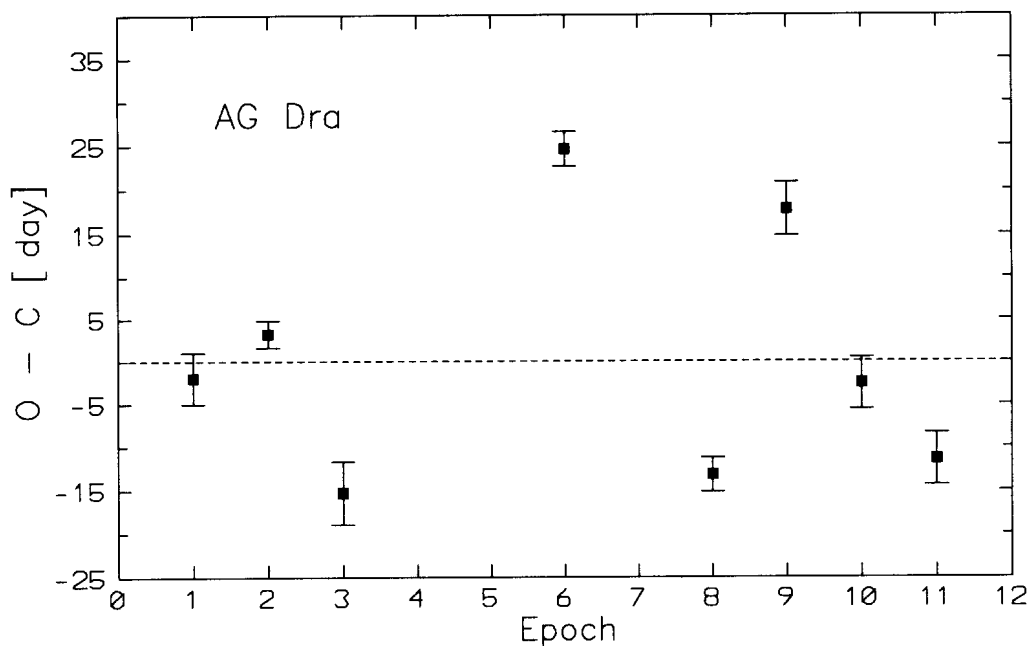
Figure 2

O−C diagram of the minima in the U/u light curve of AG Dra.

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PHOTOELECTRIC MINIMA OF ECLIPSING BINARIES

The following Table gives the photoelecric minima obtained in the years 1991-1993 at the N Copernicus Observatory and Planetarium in Brno (Czech Republic) by means of the Nasmyth type 0.4-m telescope.

The telescope was used with a single channel photometer and EMI 6256B photomultiplier. Measurements were made in the UBV-system. The integration time of one measurement was ten second.

The times of minimum brightness and their standard deviation were determined by Kwee-van Woerden's (1956) method. The name of star, the name of the filter, heliocentric time of minima, standard deviation, different values of $O-C$ and abbreviations of the observers's name are given in Table 1. The abbreviations in the column "Observer" means:

DH: Dalibor Hanžl EN: Eva Neureiterová PH: Petr Hájek TH: Tomáš Hudeček MN: Martin Navrátil MZ: Miloslav Zejda

Data for calculating the $O-C$ residuals have been taken from the following literature:

$O-C$(I): SAC 65, Krakow, 1993

$O-C$(I): GCVS, Moscow, 1985-1987

Table 1

Name			JD hel	err.	$O-C$(I)		$O-C$(II)	Obs.
RT And	V	s	48506.3373	0.0016	−0.0035		−0.0017	MN
	V		48600.3639	0.0005	−0.0019		−0.0001	MN
	B		48600.3629	0.0003	−0.0029		−0.0011	MN
	U		48600.3655	0.0004	−0.0003		−0.0015	MN
	V		48646.2751	0.0014	−0.0025		−0.0007	MN
	B		48646.2746	0.0008	−0.0030		−0.0012	MN
	U		48646.2754	0.0004	−0.0022		−0.0004	MN
DS And		V	48537.4321	0.0005	+0.0050	=	+0.0050	DH
	B		48537.4293	0.0007	+0.0023	=	+0.0023	DH
RX Ari	V		48262.3965	0.0002	−0.0073		+0.0097	DH
	B		48262.3951	0.0005	−0.0087		+0.0083	DH
TT Aur	V		48599.3018	0.0004	+0.0073		−0.0059	DH
	B		48599.3007	0.0002	+0.0062		−0.0070	DH
	U		48599.3016	0.0003	+0.0071		−0.0061	DH
BF Aur	V	s	48271.3680	0.0004	+0.0052	=	+0.0052	DH/PH
	B	s	48271.3694	0.0003	+0.0066	=	+0.0066	DH/PH
	U	s	48271.3724	0.0011	+0.0096	=	+0.0096	DH/PH
VW Cep	V		48276.4159	0.0005	−0.0000		−0.0533	EN
	B		48276.4144	0.0005	−0.0015		−0.0548	EN
GS Cep	V	s	48461.4968	0.0012	+0.0006			DH
	B	s	48461.4969	0.0020	+0.0007			DH
	V		48500.4957	0.0008	+0.0015			DH
	B		48500.4949	0.0008	+0.0007			DH
	V		48503.4394	0.0011	+0.0019			DH
	B		48503.4397	0.0006	+0.0022			DH

Table 1 (cont.)

Name			JD hel	err.	O−C(I)		O−C(II)	Obs.
GS Cep	V	s	48567.4472	0.0013	−0.0060		DH	
	B	s	48567.4484	0.0013	−0.0048			DH
V 680 Cyg	V		48445.4665	0.0023	+0.0139		+0.0433	DH/TH
	B		48445.4622	0.0008	+0.0096		+0.0390	DH/TH
TT Her	V		48444.4762	0.0011	−0.0038		+0.0138	DH/TH
	B		48444.4816	0.0008	−0.0016		+0.0192	DH/TH
	V		48839.4120	0.0011	+0.0021		+0.0209	DH
	B		48839.4124	0.0003	+0.0025		+0.0213	DH
V 566 Oph	V		48443.4616	0.0006	+0.0014		+0.0164	DH/TH
	B		48443.4623	0.0007	+0.0021		+0.0170	DH/TH
V 839 Oph	V		48500.3775	0.0009	+0.0018		+0.0741	DH
	B		48500.3772	0.0006	+0.0015		+0.0738	DH
	V		48805.4965	0.0002	+0.0048		+0.0826	DH
	B		48805.4980	0.0002	+0.0063		+0.0841	DH
FT Ori	V		48273.2980	0.0003	+0.0021	=	+0.0021	DH/EN
	B		48273.2975	0.0007	+0.0016	=	+0.0016	DH/EN
	U		48273.3009	0.0004	+0.0050	=	+0.0050	DH/EN
V 392 Ori	V		48272.3628	0.0016	+0.0070	=	+0.0070	DH
	B		48272.3601	0.0008	+0.0043	=	+0.0043	DH
GP Peg	B		48476.4195	0.0007	+0.0008		−0.0177	MZ/DH
IU Per	V		48567.3246	0.0011	−0.0176		+0.0090	DH
	B		48567.3224	0.0011	−0.0198		+0.0068	DH
	U		48567.3239	0.0028	−0.0183		+0.0083	DH
GR Tau	V		48619.2975	0.0010	+0.0008		−0.0112	DH
	B		49619.2971	0.0011	+0.0004		−0.0016	DH
BU Vul	V		48479.4249	0.0009	+0.0038		+0.0028	DH
	B		48479.4253	0.0005	+0.0042		+0.0032	DH

Moments of the secondary minima are labelled by "s". As far as the data for calculating the time of the secondary minima are not given in the above mentioned 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 "="). The GCSV period of GS Cep is definitely wrong, so corresponding (O−C) values are not given.

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NEW PHOTOELECTRIC OBSERVATIONS FOR HL AURIGAE

HL Aur is an eclipsing binary system. It was first observed by Pfau (1955) and Kippen-hahn (1955) gave a photographic light curve and a series of time of minima. Tsesevitch (1956), Locher (1976), Quester (1978), Frank (1983), Fernandes (1983), Moschner and Kleikamp (1989, 1990) published some times of minima. Most of them were obtained by visual or photographic observations except for the one given by Fernandes based on photoelectric observation.

The star was observed photoelectrically on 13 nights in winter season in 1990 and 1994, respectively by using the 60 cm reflector at Xing-long station of Beijing Astronomical Observatory.

The finding chart for comparison and check stars is shown in Figure 1. All observational data were corrected for differential atmospheric extinction and transformed into Johnson standard system.

Using Kwee–Van Woerden method six photoelectric times of minima were determined (see Table 1). The 1994 light curves of HL Aur given in Figure 2 (consisting of 150 individual observations) show that the depth of the primary minimum is 1^m07 and that of the secondary is 0^m48 and a little asymmetry between Max I and Max II may be discovered.

We derived a new improved ephemeris by using all the recent times of minima as follows:

$$Min.I = HJD\ 2447913.3470 + 0^d62250590 \times E$$
$$\pm 5 \qquad\qquad \pm 13$$

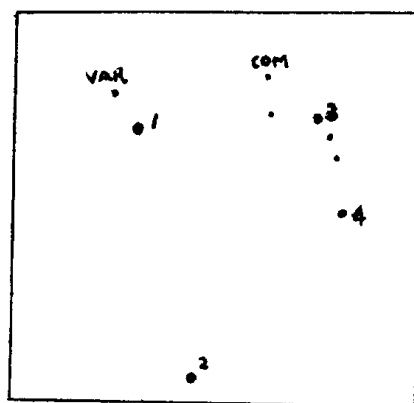From the $O-C$ diagram the period of HL Aur is nearly constant over the past 40 years.

Figure 1. The finding chart of HL Aur
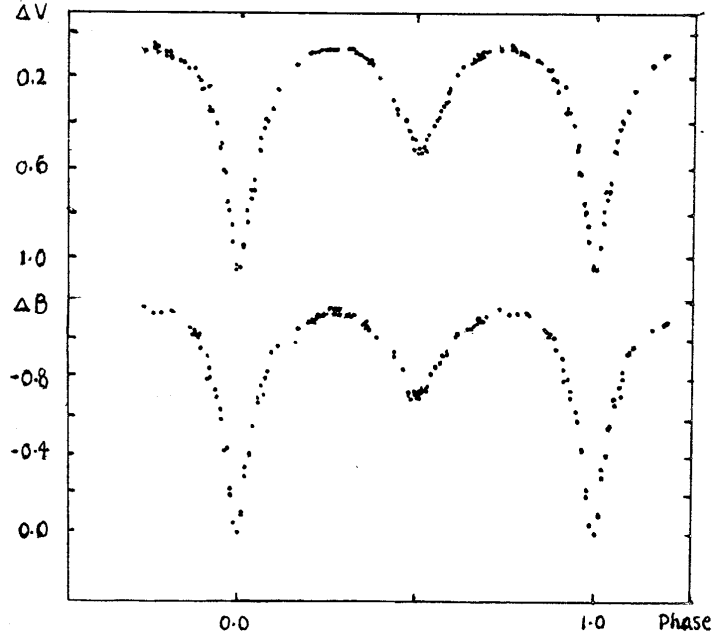1: BD+49°1478; 2: BD+49°1477; 3:BD+49°1476; 4: BD+49°1474

Figure 2. The light curves of HL Aur in BV colours.

Table 1. New times of minima

JD(Hel.)2400000+	colour	Min.	m.e.
47911.1722	V	II	0.0015
47911.1728	B	II	0.0013
47913.3470	V	I	0.0001
47913.3470	B	I	0.0002
47915.2162	V	I	0.0015
47915.2154	B	I	0.0007
49360.9873	V	II	0.0015
49362.2291	V	II	0.0006
49362.2274	B	II	0.0008
49363.1609	V	I	0.0005
49363.1616	B	I	0.0004

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Kippenhahn, R., 1955, *Astron. Nach.*, **282**, 73

Locher, K., 1976, *BBSAG*, No. 21

Moschner, W., Kleikamp, W., 1989, *BAV-Mitteilungen*, No. 52

Moschner, W., Kleikamp, W., 1990, *BAV-Mitteilungen*, No. 56

Pfau, W., 1955, *MVS*, Sonneberg, No. 198, 199

Quester, W., 1978, *BAV-Mitteilungen*, No. 29

Tsesevitch, V. P., 1956, *Astron. Circular*, No. 174

PHOTOELECTRIC OBSERVATIONS OF EP AURIGAE

EP Aur was discovered to be an eclipsing binary by Hoffmeister (1936, 1949) and is a β Lyr type binary with a period of $0\overset{d}{.}5910091$, Tsesevitch (1954) gave a complete light curve, together with 9 times of photographic minima, but no more attention was paid to this star in past 40 years. Recently, Frank (1983), Vielmetter (1989), Moschner and Kleikamp (1990), Agerer (1991) published some times of minima for this star, among which only one was photoelectric observation (Agerer, 1991), the other were photographic or visual observations.

This star was included as one of short period β Lyr binaries of our observational programme and observed by using the 60 cm reflector at Xing-long station of Beijing Astronomical Observatory from December 1990 to February 1991.

Comparison and check stars are very near to the binary. The finding chart is shown in Figure 1. All individual observational were corrected for differential atmospheric extinction and transformed into standard UBV system. A total of 371 observations in each B and V colour were obtained, including one primary and three secondary times of minima. The light curves in BV bands are shown in Figure 2. From the light curves we can derive the depth of the primary minimum to be about $0\overset{m}{.}7$ and that of the secondary about $0\overset{m}{.}2$.

The times of minima were estimated by using Kwee–Van Woerden method. A new ephemeris based on our new times of minima together with published minima in literature is derived as follows:

$$\text{Min.I=HJD } 2448245.2312+0\overset{d}{.}59100742\times\text{E}$$
$$\pm 11 \qquad\qquad \pm 10$$

Table I. New times of minima of EP Aur.

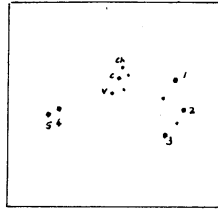| JD(Hel.)2400000+	colour	Min.	m.e.
48245.2373	V	I	0.0005
.2362	B	I	0.0005
48246.1070	V	II	0.0001
.1153	B	II	0.0008
48272.1151	V	II	0.0001
.1175	B	II	0.0001
48273.3120	V	II	0.0009
.3097	B	II	0.0001

Figure 1. The finding chart of EP Aur.
1: BD+31°1219, 2: BD+31°1217; 3: BD+31°1221, 4: BD+31°1226; 5: BD+31°1227
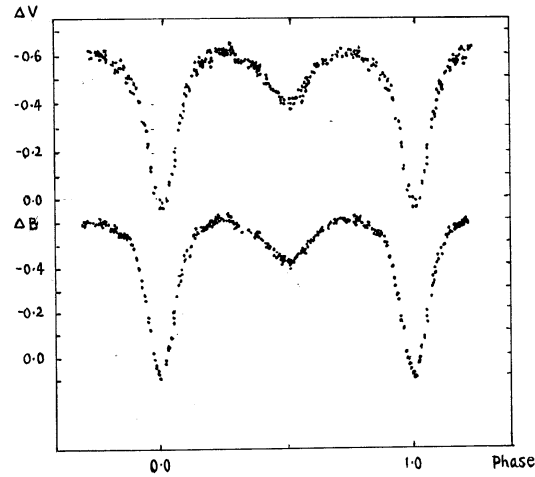c: comparison star; ch: check star

Figure 2. The light curves of EP Aur in BV colours.

From the O−C diagram, the period of this star is nearly constant. The times of minima collected for this star were not enough to cover all the important parts of the O−C diagram, so the conclusion has to be confirmed.

A further analysis of the light curves is in progress.

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Frank, P., 1983, *BAV-Mitteilungen*, No. 36
Hoffmeister, C., 1936, *Astron. Nach.*, **259**, Nr. 6195
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CIRCULAR POLARIMETRIC OBSERVATIONS OF THE MAGNETIC CV 1H1752+081

1H1752+081 was discovered using the *HEAO-1* satellite and identified with an eclipsing CV whose period was 113 mins (Silber et al. 1994, Barwig, Ritter & Bärnbantner 1994). The eclipse is unusual in that the ingress to eclipse is more variable and twice as long as the egress. Silber et al. (1994) claim that the system has a small accretion disk with the possibility that it is an intermediate-polar (a close binary in which the primary is a mass accreting white dwarf with a magnetic field strength B=1–10MG). On the other hand, Barwig et al., (1994) suggest that their observations are consistent with the object being an AM Her system (a close binary in which the primary is a mass accreting white dwarf whose spin period is coupled with the orbital period and has a magnetic field strength B=10–70MG; sufficiently strong to prevent the formation of an accretion disc). The AM Her systems show strongly variable circular polarisation while the intermediate-polars have generally undetectable levels of circular polarisation, with the exception of BG CMi (Penning, Schmidt & Liebert, 1986) and RE0751+14 (Rosen, Mittaz & Hakala, 1993). These have detectable but lower values of circular polarisation than found in AM Her systems and inferred magnetic field strengths at the lower end of the range found for AM Hers. 1H1752+081 was observed spectroscopically during a low intensity state and was found to have a magnetic field strength $B \sim$7MG (Ferrario et al., 1994). Such a low magnetic field strength suggests that the object would exhibit low levels of circular polarisation. To confirm this we obtained circular polarimetry of 1H1752+081 covering two orbital cycles.

We made observations of 1H1752+081 at two separate epochs using the Anglo Australian Telescope. The Faint Object Polarimeter was used with a Tektronix CCD as the detector and an OG570 filter ($\sim$5500–9500Å). Both photometry and circular polarisation data were obtained on 1994 July 3 for 113 mins and 133 mins the following day. The exposures were 30 sec in duration. The data were reduced as described by Cropper et al. (1990).

Figures 1 & 2 show the photometric and polarimetric data folded on the ephemeris of Barwig et al. (1994). The photometric light curve is similar in shape to that reported by Barwig et al. (1994) and Silber et al. (1994). However, the main point of interest is the very low level of circular polarisation. Although a positive level of circular polarisation was recorded on each night, the observations of unpolarised standard stars using the same instrumental configuration are inadequate for ruling out the possibility that this low level of polarisation is instrumental in origin. This view is strengthened by the fact that the phased circular polarisation is different on the two nights. We therefore conclude that any circular polarisation in 1H1752+081 is $\leq$1%.

These results coupled with the low magnetic field strength determined by Ferrario et al. (1994) suggest that 1H1752+081 is not in fact an AM Her star but is more likely to be an intermediate-polar.
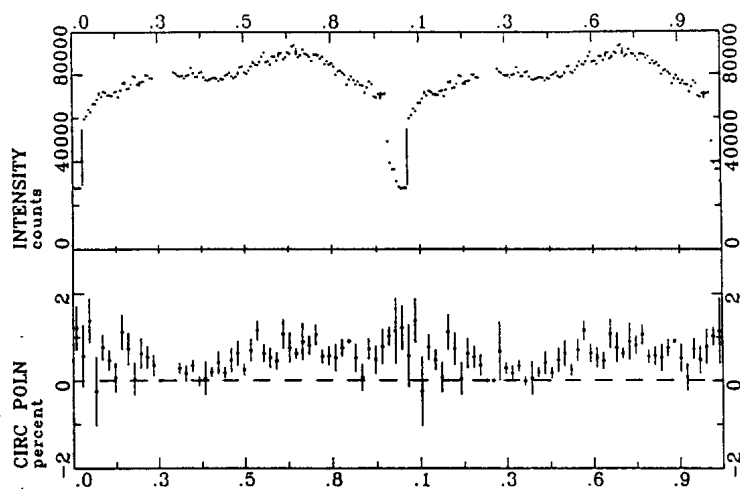
Figure 1. Circular polarisation and photometric data (folded on the ephemeris of Barwig et al., 1994) taken on 1994 July 3 with the OG570 filter.
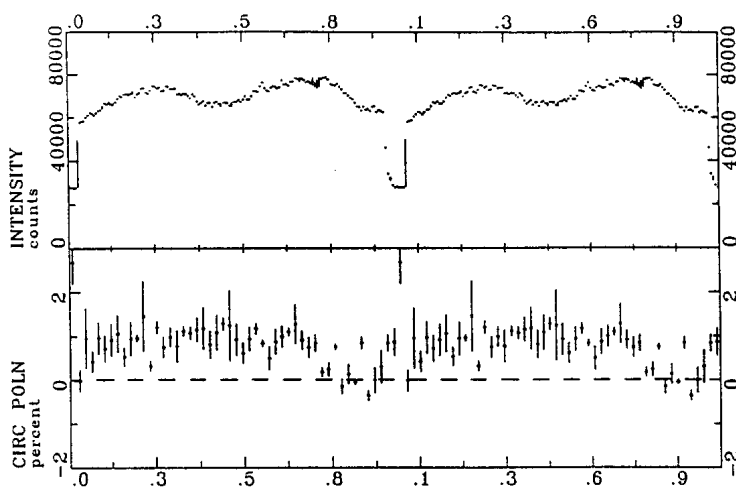

Figure 2. Circular polarisation and photometric data (folded on the ephemeris of Barwig et al., 1994) taken on 1994 July 4 with the OG570 filter.

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