COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4335

Konkoly Observatory
Budapest
2 May 1996
HU ISSN 0374 – 0676

OBSERVATIONS OF LOW-AMPLITUDE LATE-TYPE VARIABLES

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

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

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

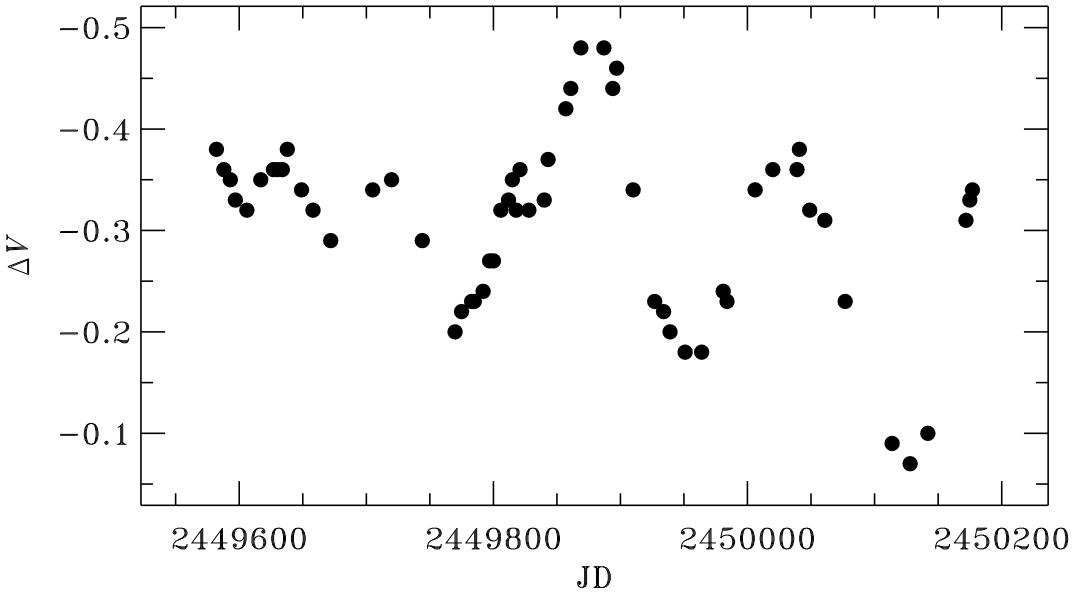

Figure 1. Light curve of UX Dra

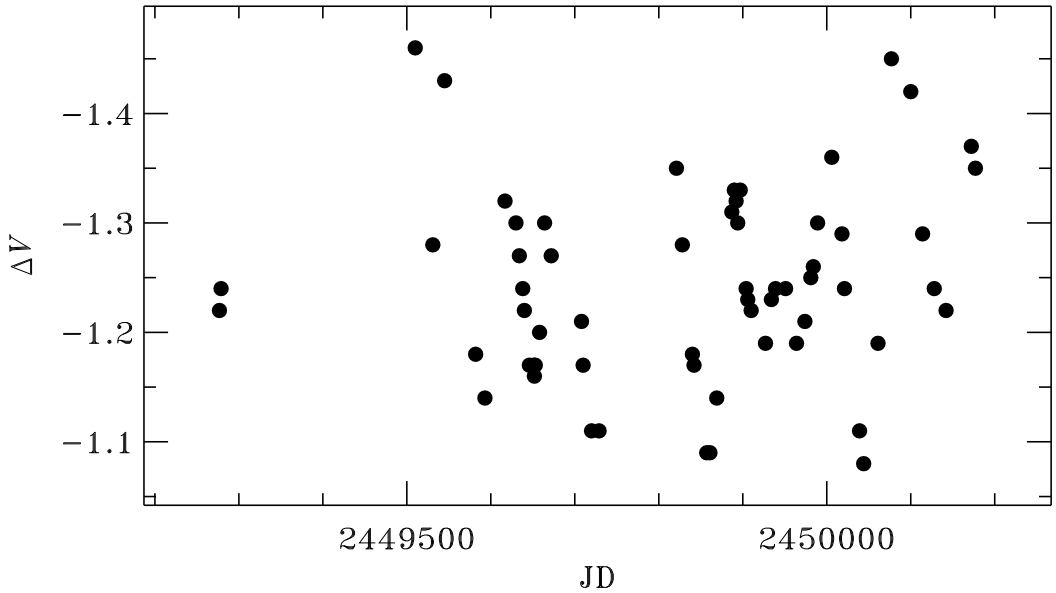

Figure 2. Light curve of δ^2 Lyr

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

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

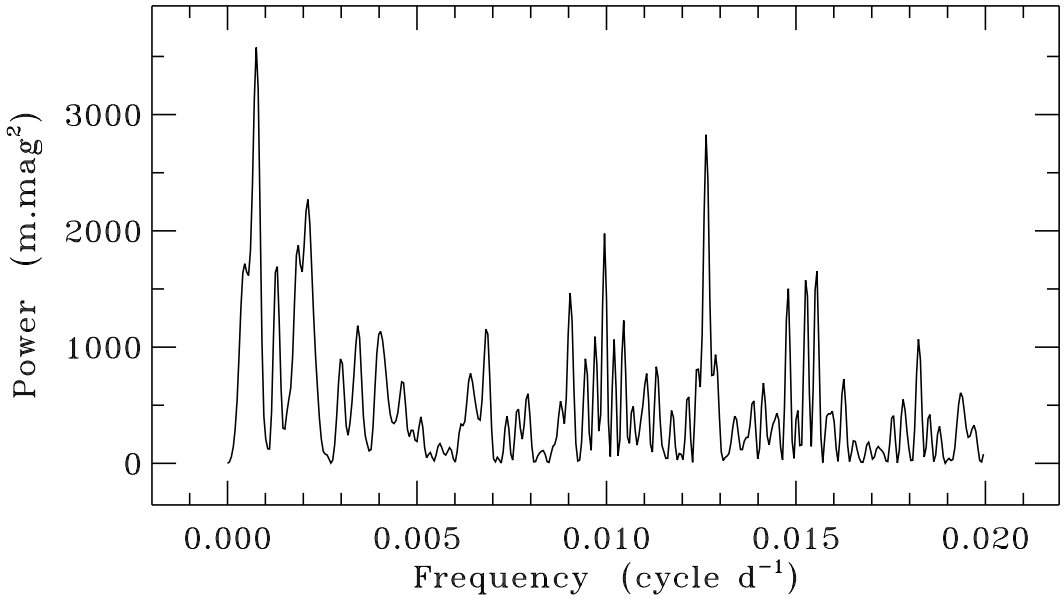

Figure 3. DFT power spectrum of the new photometry of δ^2 Lyr combined with that of Bakos & Tremko

Table 1. Comparison star information

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

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

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

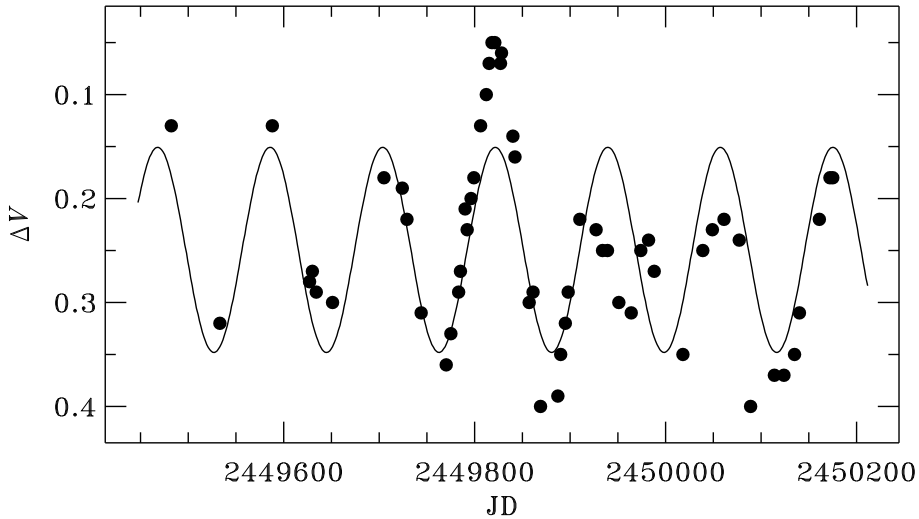

Figure 4. Light curve of VY UMa with the 118 day period superimposed

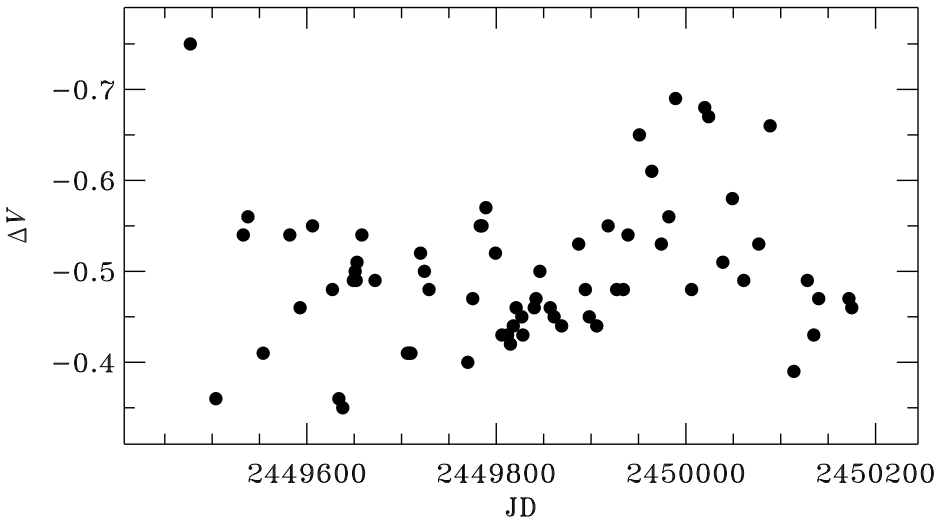

Figure 5. Light curve of RR UMi

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

C. LLOYD
Rutherford Appleton Laboratory
Chilton, Didcot
OXON OX11 0QX, UK
cl@ast.star.rl.ac.uk

K. W. WEST
5, Edward Street
Ryde
Isle of Wight PO33 2SH, UK
kwest@aladdin.co.uk

References:

Bakos, G.A. & Tremko, J., 1990, *Contr. Astron. Obs. Skalnate Pleso*, **21**, 99
Batten, A.H. & Fletcher, J.M., 1986, *PASP*, **98**, 647
Eggen, O.J., 1993, *AJ*, **104**, 275
Jorissen, A. et al., 1993, *A&A*, **271**, 463
Kholopov, P.N. et al., 1985 *General Catalogue of Variable Stars*, 4th edn., Moscow
Little, S.J., Little-Marenin, I.R. & Bauer, W.H., 1987, *AJ*, **94**, 981
Ofek, E.O., Shemmer, O. & Gabzo, O., 1995, *J. BAA*, **105**, 33
Percy, J.R. et al., 1994, *PASP*, **106**, 611
Percy, J.R., Desjardins, A., Yu L. & Landis, H.J., 1996, *PASP*, **108**, 139
Vetesnik, M., 1983, *IBVS*, No. 2329