

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

Number 5844

Konkoly Observatory
Budapest
29 July 2008

HU ISSN 0374 – 0676

MULTICOLOUR CCD PHOTOMETRY OF THREE RRab STARS

JURCSIK, J.¹; SÓDOR, Á.¹; HURTA, ZS.^{2,3}; KŐVÁRI, ZS.¹; VIDA, K.^{2,3}; HAJDU, G.²; NAGY, I.²; DÉKÁNY, I.¹; POSZTOBÁNYI, K.⁴; KOPONYÁS, B.²; VÁRADI, M.⁵; VITYI, N.²

¹ Konkoly Observatory of the Hungarian Academy of Sciences, P.O. Box 67, H-1525 Budapest, Hungary; e-mail: name@konkoly.hu

² Eötvös Loránd University, Department of Astronomy, P.O. Box 32, H-1518 Budapest, Hungary

³ Visiting Astronomer, Konkoly Observatory of the Hungarian Academy of Sciences

⁴ AEKI, KFKI Atomic Energy Research Institute, Thermohydraulic Department, H-1525 Budapest 114, PO Box 49, Hungary

⁵ Observatoire de Genève, Université de Genève, CH-1290, Sauverny, Switzerland

In the present paper we publish the third set of our observations of monophasic fundamental mode RR Lyrae stars. The first and second sets of RRab light curves were published in Jurcsik et al. (2006) and Sódor et al. (2007), respectively. CCD observations of short period ($P < 0.5$ d), northern variables are obtained in order to determine the true incidence rate of light curve modulation occurring in these stars.

Now light and colour curves of BK And, UU Boo, and V387 Per are presented. The observations were made with the 60 cm automatic telescope of Konkoly Observatory, Svábhegy, Budapest, equipped with a Wright 750x1100 CCD camera using $BVR_C I_C$ filters. Data reduction and aperture photometry were performed using standard IRAF[†] packages. Second order extinction correction of the B data were taken into account, with $\kappa'' = 0.02$ coefficient. Instrumental magnitudes were transformed to the $BVR_C I_C$ system by observing standard magnitude stars determined by A. Henden in the fields of CZ Lacertae and MW Lyrae (Jurcsik et al. 2008, and Sódor et al. in preparation). Log of observations and comparison stars' data are given in Table 1.

Light curves of BK And and V378 Per were previously published by Schmidt & Reisinger (1993) and Schmidt & Seth (1996), respectively. These observations contained, however only 10-20 V and R CCD data points, that are not enough for accurately describe the light variations of the stars. Observations of UU Boo were obtained by Sturch (1966) and Bookmeyer et al. (1977). This light curve is, however, incomplete and noisy. Our observations are the first complete, accurate, multicolour light curves of these variables. The time coverage of the data also allows us to conclude that the light curves of these stars are stable, no light curve modulation with amplitude larger than ~ 0.02 mag in maximum brightness occur.

The photometric data are available electronically from the IBVS website (5844-t5.txt – 5844-t16.txt). The Tables list the relative $BVR_C I_C$ magnitude and relative $B - V$, $V - R_C$, $V - I_C$ colour time series with respect to the comparison stars. We checked

[†]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

the constancy of the brightness of the comparisons by measuring magnitude differences to several check stars in our respective field of views. The *r.m.s.* scatter of these data is between 0.006 and 0.012 mag in each band. This is in accordance with the *r.m.s.* scatter of the Fourier fits of the B, V, R_C, I_C light curves of BK And, UU Boo, and V378 Per, which are 0.012/0.008/0.009, 0.011/0.011/0.010/0.011, and $-/0.010/0.010$ mag, respectively. The V light curves and the colour curves of the three stars are plotted in Figs. 1 – 3.

Table 1. Log of observations

Star	Comparison			V^* [mag]	Observation period		No. of	
	GSC 2.3.2	RA(2000)	DEC(2000)		JD 2400000 +	nights	$B/V/R_C/I_C$ data	
BK And	N078000076	23 35 08.29	+41 04 09.1	13.16	54413 – 54512	20	391 / 391 / 0 / 373	
UU Boo	N6AZ000508	15 17 36.40	+35 05 29.5	11.90	54171 – 54567	16	338 / 330 / 328 / 320	
V378 Per	NCGO000977	03 55 02.99	+32 39 10.6	12.82	54413 – 54509	15	0 / 578 / 0 / 573	

* V magnitudes of the comparison stars are from GSC 2.3.2

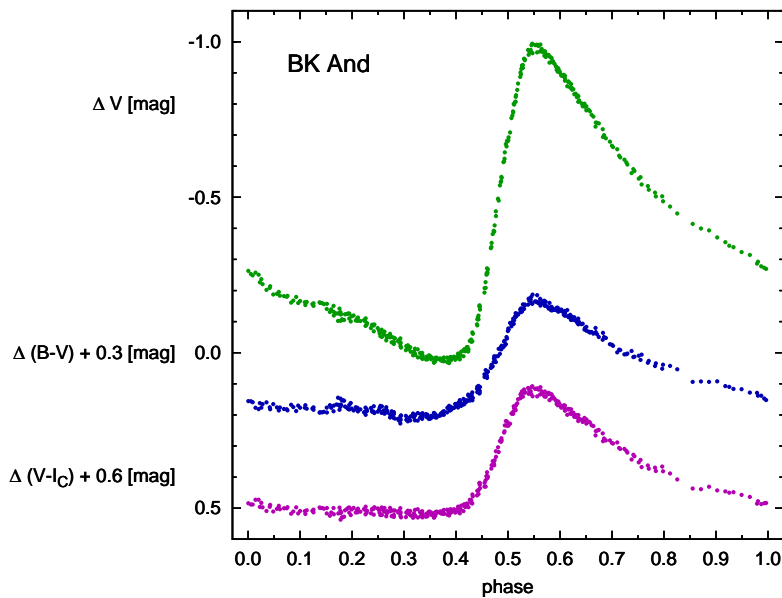


Figure 1. Differential V , $B - V$ and $V - I_C$ light and colour curves of BK And.

Table 2. Normal maximum timings of the V light curves.

Star	$T_{\max} - 2400000$ [HJD]
BK And	54452.2082
UU Boo	54197.3875
	54491.653
V378 Per	54474.2780

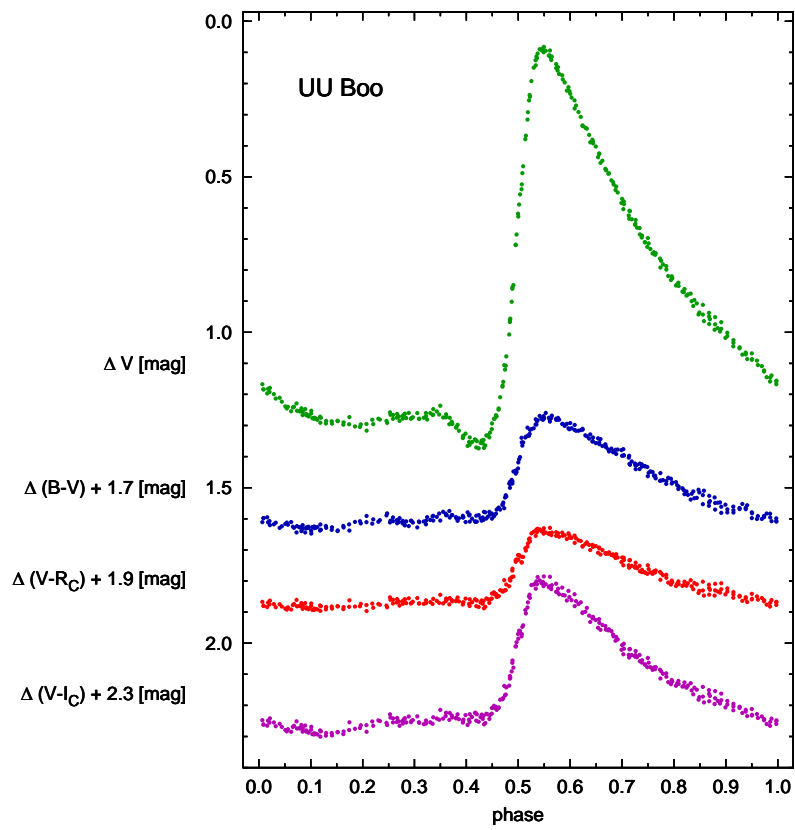


Figure 2. Differential V , $B - V$, $V - R_C$ and $V - I_C$ light and colour curves of UU Boo.

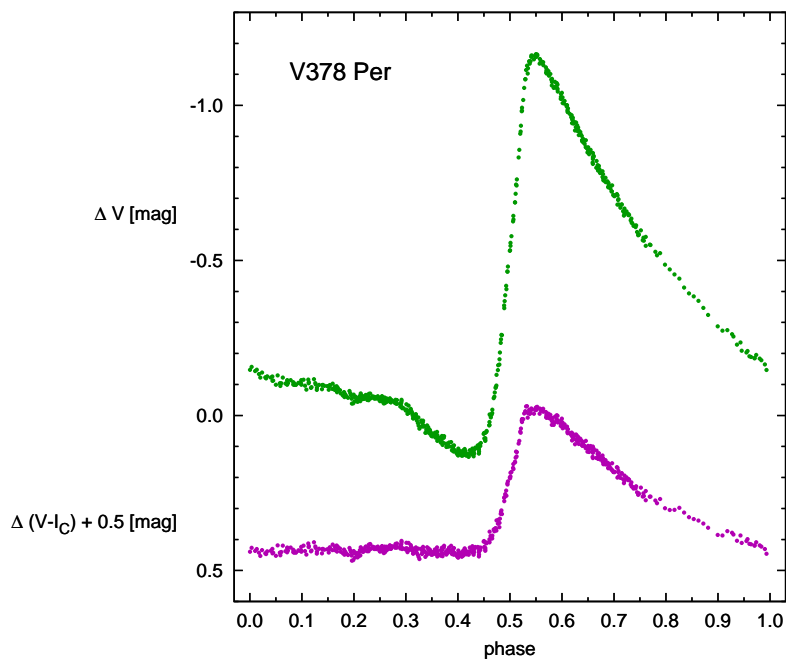


Figure 3. Differential V and $V - I_C$ light and colour curves of V378 Per.

Table 3. Fourier parameters of the V light curves.

Star	P [d]	A_1 [mag]	R_{21}	R_{31}	R_{41}	R_{51}	ϕ_{21}^* [rad]	ϕ_{31}^* [rad]	ϕ_{41}^* [rad]	ϕ_{51}^* [rad]
BK And	0.4216093(8)	0.360	0.518	0.321	0.159	0.109	2.671	5.410	1.990	4.688
UU Boo	0.4569339(2)	0.454	0.458	0.341	0.228	0.161	2.244	4.707	1.037	3.687
V378 Per	0.3987208(5)	0.417	0.555	0.371	0.246	0.161	2.337	5.112	1.469	4.206

* Phase differences are given according to sine term decomposition.

Seasonal normal maximum timings and Fourier parameters of the V light curves of BK And, UU Boo, and V378 Per are listed in Table 2, and Table 3, respectively.

Table 4 compares the photometric metallicities calculated from the V light curves of the variables according to Eq. 3 of Jurcsik & Kovács (1996) to the results of spectroscopic metallicity measurements.

Table 4. Spectroscopic and photometric $[\text{Fe}/\text{H}]$ values.

Star	$[\text{Fe}/\text{H}]_{\text{phot}}$	$[\text{Fe}/\text{H}]_{\text{spect}}^a$	ref.
BK And	-0.04	0.10	Layden (1994)
UU Boo	-1.17	-1.64	Layden (1994)
		-1.00	Kinman & Carretta (1992)
V378 Per	-0.31	-	

a : Spectroscopic metallicities are transformed to the $[\text{Fe}/\text{H}]$ scale used for the photometric metallicities according to Eq. 3, and Eq. 2 of Jurcsik (1995) and Jurcsik & Kovács (1996).

We thank Béla Szeidl for his many helpful comments on this work. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. The financial support of OTKA grants T-048961, and T-068626 is acknowledged. ZsK is a grantee of the Bolyai János fellowship of the HAS.

References:

- Bookmeyer, B.B., Fitch, W.S., Lee, T.A., Wisniewski, W.Z. and Johnson, H.L. 1977, *Rev. Mex. Astron. Astrofis.*, **2**, 235
- Jurcsik, J. 1995, *Acta Astronomica*, **45**, 653
- Jurcsik, J., & Kovács, G. 1996, *A&A*, **312**, 111
- Jurcsik, J., Sódor, Á., Váradi, M., Vida, K. et al. 2006, IBVS No. 5709
- Jurcsik, J., Sódor, Á., Hurta, Zs., Váradi, M., Szeidl, B., Smith, H. A., Henden, A. et al. 2008, *MNRAS*, in press, arXiv:0807.0534
- Kinman, T. D. & Carretta, E. 1992, *PASP*, **104**, 111
- Layden, A. 1994, *AJ*, **108**, 1016
- Schmidt, E.G. & Reiswig, D.E. 1993, *AJ*, **106**, 2429
- Schmidt, E.G. & Seth, A. 1996, *AJ*, **112**, 2769
- Sódor, Á., Jurcsik, J., Nagy, I., Váradi, M. et al. 2007, IBVS No. 5793
- Sturch, C. 1966, *ApJ*, **143**, 774