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

Number 5655

Konkoly Observatory
Budapest
26 October 2005

HU ISSN 0374 – 0676

SOUTHERN RR LYRAE STARS EXHIBITING THE BLAZHKO EFFECT

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A fraction of the RR Lyrae variable stars show a cyclic modulation of the amplitude and shape of their light curves, known as the Blazhko effect (Blazhko, 1907). This effect has periods typically of the order of tens of days, and manifests itself as additional frequencies in the periodogram, very close to the main frequency. Its cause is not yet well understood.

Recently a large number of new variables were discovered in the Southern sky by the All Sky Automated Survey (ASAS3; Pojmanski, 2002 and 2003 and Pojmanski and Maciejewski, 2004 and 2005), among which there are a substantial number of RR Lyrae stars. Complete light curves of already known variables were obtained for the first time also. In this paper the RRab stars found by ASAS3 were studied more closely to search for the presence of the Blazhko effect.

We have chosen those RRab stars for detailed study from the ASAS database for which the folded light curve showed signs of modulation by visual inspection, i.e. increased scatter around the rising branch and light maxima. We analyzed the Fourier spectra of the candidate stars' light curve using the abilities of the MUFRAN package (Kolláth, 1990). We looked for modulation peaks in the prewhitened Fourier spectra around the pulsation frequency and its harmonics. We also scanned the whole possible modulation frequency range (from 0.0007 c/d to 0.2 c/d) looking for any feasible modulation frequency. During this process we fitted the light curve with the pulsation frequency, its harmonics and the first four trial modulation frequencies (i.e. $f_0 \pm f_{\rm mod}$ and $2f_0 \pm f_{\rm mod}$), and searched for a modulation frequency which gave significantly reduced *rms* scatter of the fit, than the fit with only the pulsation frequency and its harmonics. We also examined whether the light curve folded with the pulsation period at different phases of the modulation showed significant changes in shape and amplitude. We accepted a candidate star to exhibit light curve modulation only if all the three tests were positive with the same modulation frequency.

The stars for which the Blazhko effect was positively identified are presented in Tables 1 and 2. In Table 1 we give new elements for the Blazhko RR Lyrae stars with already published Blazhko period. Here the old Blazhko periods are also given. In Table 2 data of the newly discovered or previously suspected Blazhko stars are given. The tables include the objects' GSC number, ASAS3 coordinates, the pulsation and the Blazhko periods in days and GCVS names (Kholopov et al., 1985) if exist. In Table 3, which is available only electronically[1], we give the Fourier parameters of the light curve fit for all stars. Table 3

[1] Available on the IBVS website as `5633-t3.txt`

includes the GCVS name or ASAS identifier of the star, the pulsation and modulation frequencies, the amplitudes $(A_1, ... A_8)$ and phases $(\phi_1, ... \phi_8)$ of the pulsation frequency and its harmonics, the amplitudes $(A_9, ... A_{12})$ and phases $(\phi_9, ... \phi_{12})$ of the first four modulation frequencies, the *rms* scatter of the fit and the epoch which the phases refer to. The phases correspond to a sine-term solution.

We got ambiguous results for two stars, namely for GSC 6756-0012 and for CK Aps. They seem to be modulated according to all the three tests, but the effect is very weak compared to the scatter of the measurements. The suspected modulation periods are 74 d and 56 d for GSC 6756-0012 and CK Aps respectively.

Phase plots at different phases of the Blazhko period are shown in Fig. 1 and Fig. 2 for UV Oct and NSV 4350 respectively.

Animated figures for some of the stars are electronically available also.

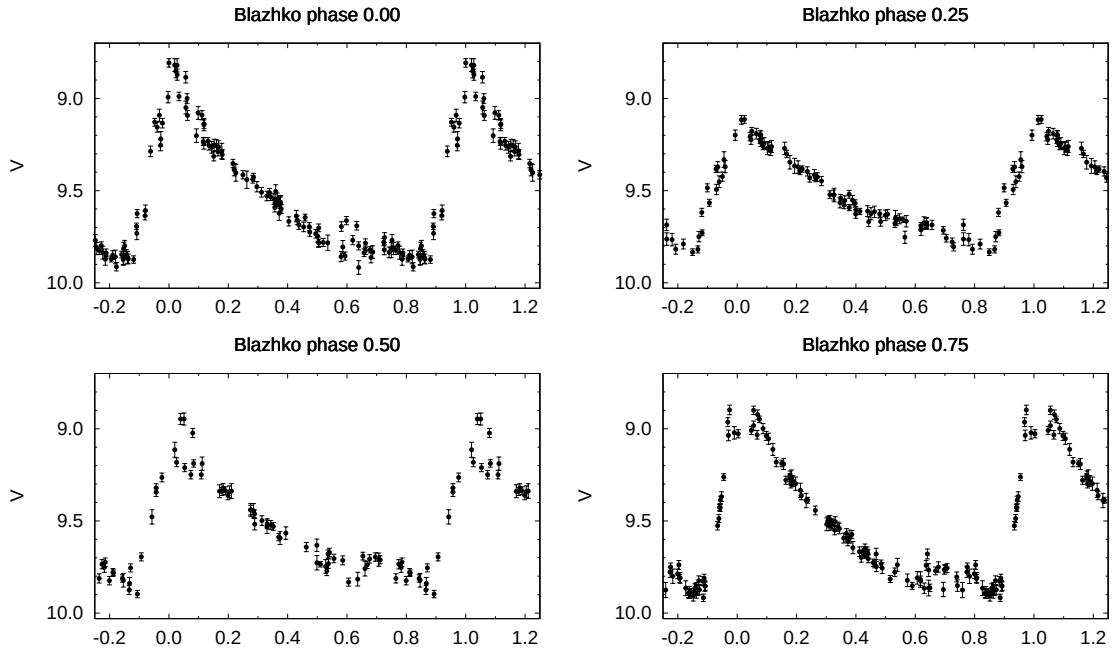

Figure 1. ASAS3 phased light curves of UV Oct at different phases of the Blazhko cycle.

Acknowledgements: Sebastián Otero, John Greaves and Johanna Jurcsik are acknowledged for helpful suggestions. This research has utilized the ASAS3 public photometry catalogue, and the SIMBAD and VizieR databases operated at the *Centre de Données Astronomiques (Strasbourg).* Á. S. acknowledges the financial support of OTKA grants T-043504 and T-048961.

Table 1: New elements of known Blazhko RR Lyrae stars.

GSC	ASAS ID	$P_{\rm puls}$ [d]	$P_{\rm Bl}$ old [d]	Ref.	P_{Bl} new [d]	GCVS	Note
8866-1496	032520−6503.3	0.49201	> 45	1	161	X Ret	
7591-1523	051508−4137.7	0.47884	90:	2	82	RY Col	
5458-0044	091349−0919.1	0.53723	25.8	3	26.3	SZ Hya	*
6675-0028	120447−2740.7	0.65033	≈ 30	4	72	IK Hya	
6730-0109	141345−2254.7	0.44794	≈ 26	5	26.6		*
9522-0447	163225−8354.2	0.54258	82:	1	145	UV Oct	*

* Animated figure is available electronically.
References: (1) Hoffmeister, 1956; (2) Kinman, 1960; (3) Kanyó, 1970; (4) Andrews et al., 1982; (5) Wils & Greaves, 2004.

Table 2: Elements of new and suspected Blazhko RRab stars of the ASAS database.

GSC	ASAS ID	$P_{\rm puls}$ [d]	$P_{\rm Bl}$ [d]	GCVS	Ref.	Note
5847-1684	003338−1529.2	0.57373	256	RX Cet	1	
7540-0920	010949−4418.9	0.48440	62.5	NSV 420		
6432-1585	020752−2651.9	0.49543	34.8	SS For	1	
5281-1037	021515−1048.0	0.62341	112	RV Cet	2	*
6442-0690	031113−2629.0	0.59731	31.8	RX For	1	
5885-0757	040011−1949.6	0.60225	122			
5318-0800	041117−1350.9	0.55426	50	XY Eri	1	
8082-0469	044131−5216.6	0.54861	34.0	NSV 1700		
8905-0975	060746−6658.6	0.57057	25.9	VW Dor	1	
7084-0453	061315−3715.0	0.59376	130	RX Col	1	
9506-1365	085448−8317.0	0.47786	36.8	NSV 4350		*
6619-1146	102608−2315.2	0.59826	59			*
8207-1400	105303−4954.4	0.52741	59	AF Vel	3	*
0847-0851	110137+0810.0	0.53408	179	SZ Leo	2	
5515-0451	112614−1404.1	0.50290	63	NSV 5200		*
5520-0554	114856−1026.5	0.73284	143	X Crt	2	
6672-0596	121206−2612.8	0.39878	48.3			
6686-0081	123030−2602.9	0.47855	63	SV Hya	1	
6120-0430	132333−1639.9	0.61509	49.8	AM Vir	2	
5590-0758	145315−1435.9	0.54007	41.7			
8297-1427	150327−4756.1	0.60058	49.5			
7833-0197	150924−4319.6	0.38215	42.4	FU Lup		
7842-0863	155553−4041.7	0.58198	48.8	NSV 7330		
5613-0312	161256−0827.5	0.54871	78	BT Sco	4	
6811-0414	170223−2422.0	0.46137	22.2			*
7376-0369	174048−3132.6	0.42730	455	V494 Sco	2	
8352-0201	175911−4926.0	0.45186	49.5	S Ara		
7911-1078	180537−4350.0	0.55949	35.5	WW CrA		
9089-0842	195142−6244.1	0.55144	571	FO Pav		
7448-0418	195927−3400.1	0.37972	45.7			
8814-0696	212433−5712.1	0.60514	133			
9532-0988	214714−8739.0	0.45800	244	RS Oct	1	
8437-1538	215159−4559.1	0.51216	87	RT Gru	5	
9524-1884	215335−8246.7	0.62185	145	SS Oct	1	
8826-0640	223427−5635.4	0.61499	63			
6964-0926	225248−2442.2	0.52956	182			
5828-0847	232031−1447.9	0.62697	54			

* Animated figure is available electronically.
References: (1) Kovács, 2005; (2) Jurcsik & Kovács, 1996; (3) Breger, 1965; (4) Zessewitsch & Szczepanowska, 1967; (5) Clube et al., 1969.

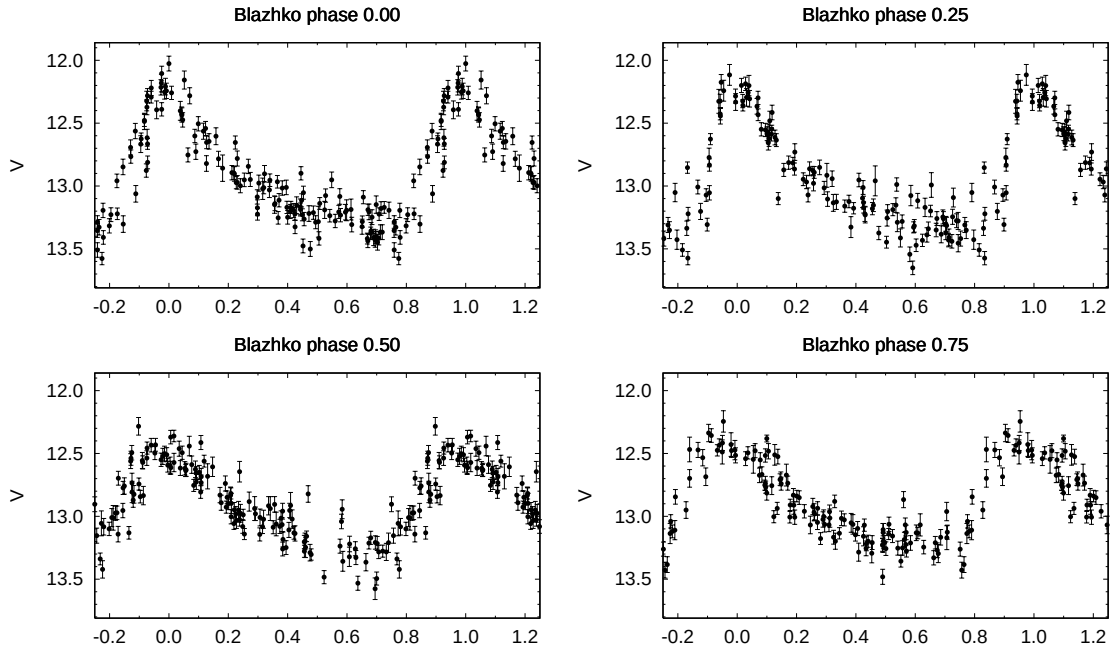

Figure 2. ASAS3 phased light curves of NSV 4350 at different phases of the Blazhko cycle.

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