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Photometric observations of southern Blazhko Stars

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Abstract

In the years 2004 and 2005, we obtained Johnson B and V photometry of 7 southern Blazhko RR Lyrae stars at the South African Astronomical Observatory (SAAO) and Siding Spring Observatory (SSO), Australia. Using the new data in combination with the ASAS data, Blazhko periods could be determined with unprecedented accuracy.

Individual Objects: AR Ser, RU Cet, RV Cap, V674 Cen, RY Col, SS For, UV Oct

Motivation

Dedicated photometric campaigns of Blazhko stars - i.e., RR Lyrae stars showing a periodic change of their pulsation amplitude and phase - have so far mainly been carried out from the northern hemisphere. Before the results from large-scale surveys such as ASAS and ROTSE-I (Woźniak et al. 2004) came out, there were only few well-established southern field Blazhko stars. We selected some of the brightest and most interesting known Blazhko pulsators in the southern hemisphere and obtained new precise photoelectric measurements. Seven stars were observed in the framework of the campaign. Table 1 lists the targets and the amount of data obtained.

The campaign

Fourteen weeks of telescope time in 2004 and twelve weeks in 2005 were allocated to the project at the South African Astronomical Observatory. Additionally, two of the stars (SS For and UV Oct) were included into a multisite campaign which was carried out in 2005. For these stars, we also obtained data at Siding Spring Observatory, Australia, which led to a great improvement of the spectral window function and made more detailed analyses possible.

	hours	nights	measurements V	measurements B
AR Ser	37.4	18	293	244
RU Cet	17.9	4	123	122
RV Cap	55.9	21	372	254
V674 Cen	77.1	30	469	441
RY Col	58.0	24	293	301
SS For	201.8	50	1218	1218
UV Oct	134.9	47	832	832

	$P_{Pulsation}$(d)	$P_{Blazhko}$(d)
AR Ser	0.57514	110.0 ± 5.0
RU Cet	0.58628	97.9 ± 1.0
RV Cap	0.44774	232.6 ± 5.5
V674 Cen	0.49392	Not determined
RY Col	0.47886	82.4 ± 0.8
SS For	0.49543	34.9 ± 0.1
UV Oct	0.54263	143.9 ± 0.2

Frequency analysis

For the determination of the frequencies we performed a Fourier analysis using the software package Period04 (Lenz & Breger 2005). In order to obtain the most reliable results, we combined our data with the publicly available data from the ASAS survey (Pojmanski 2005). The ASAS observations have a much longer time base, which complements our measurements with their precision and their coverage of large parts of the light curve. This enabled us to determine the Blazhko periods of six stars with unprecedented accuracy:

Amplitude decrease and influence of data sampling

It was noted by Jurcsik et al. (2005) that the amplitudes of the side peaks decrease less steeply from one harmonic order to the next than the amplitudes of the harmonics themselves. We also see this effect in our data. The amplitudes of the harmonics decrease exponentially, while the amplitudes of the modulation components decrease in an almost linear way.

It is well known that data sampling plays an important role in the analysis of RR Lyrae Blazhko stars. Not only the resulting amplitudes depend on the sampling, but due to phase changes also the determined pulsation amplitude may differ from one subset to another. The combination of our data with ASAS data helped to solve this problem and to obtain unambiguous results for both the pulsation and the Blazhko periods (Kolenberg et al. 2008).

Variations at minimum light

In the majority of Blazhko stars the variations around maximum light over the Blazhko cycle are most pronounced. For SS For, strong periodic variations around minimum light were found and analyzed (Guggenberger & Kolenberg 2006). Shock waves passing through the stellar atmosphere are thought to be responsible for the bump in the light curves of RR Lyrae stars. The variation of the bump is hence likely due to a variable timing and intensity of the shock wave. The light curves of some of the other stars in the campaign also show strong changes before minimum light which deserve further analysis.

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