Period Analysis of the Light Curves of Three Semiregular Variables: AA Cygni, U Delphini, and RX Bootis

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Abstract New visual observations confirm the presence of the ~210-day period in the light curve of AA Cyg, and the ~1150-day period in U Del. RX Boo exhibits double periodicity, with periods of 160 and 278 days, present since 1991. Clearly, RX Boo is a new member of the small group of double-mode red giants.

1. Introduction

Observations of the SRb variables U Del and RX Boo were made with 7×50 binoculars; the SRb variable AA Cyg was observed with 20×80 binoculars. The stars' magnitudes were estimated using the comparison stars from the AAVSO charts. The data were analyzed by means of Fourier periodograms in order to find possible periodicities. In Table 1, the periods derived from my data are compared with previous determinations.

2. Observations and results

2.1. AA Cygni

My observations of this star, covering the years 1989–1997, contain 278 individual estimates. The Fourier periodogram of these data reveals a single period of 208.8 days, which agrees very well with the value given in the *General Catalogue of Variable Stars* (GCVS, Kholopov *et al.* 1985).

2.2. U Delphini

I observed this star beginning in 1975. The Fourier periodogram of these data, containing 541 individual estimates, reveals a single peak at the frequency corresponding to the period of about 1,152 days. This value agrees very well with recent estimates of the period of U Del made by other authors (see Table 1).

2.3. RX Bootis

The light curve of this star, derived from 396 observations made during the years 1981–1997, is shown in Figure 1. This figure clearly shows that the light changes of this star prior to ~JD 2448300 were rather irregular. After this epoch, when the star's brightness fell down to magnitude 8.6, cyclic variations appeared. The Fourier periodogram calculated for the data made after JD 2448300 (Figure 2) reveals the presence of two periods: 278 and 160 days. They are quite different from those given in other sources (see Table 1). Both periods found in RX Boo are typical for semiregular variables. Moreover, the period ratio (1.74) fits the characteristics of

other double-mode SR variables very well. This is shown in Figure 2, where period ratios of double-mode SR variables are plotted as a function of the longer of the two observed periods. The data for this figure were taken from the compilation of Szatmáry *et al.* (1996).

3. Addendum, 2006

The observations obtained in the years 1997–2006 provide an update to the conclusions concerning the periodicities detected in the light changes of the three studied semiregular variables. The new results are the following.

3.1. AA Cygni

The updated value of the main period is 206.1 days, in a very good agreement with previous determination. There is evidence of a 376-day secondary period.

3.2. U Delphini

The main periodicity is confirmed, and the updated period is found to be 1,163 days. The light curve is non-sinusoidal in shape with a steep decline and slow increase of brightness.

3.3. RX Bootis

The star shows double-period behavior in the time interval between JD 2448300 and 2452200, then the pulsations cease. The two periods are equal to 158 and 293 days. The first periodicity has larger amplitude than the other.

4. Acknowledgements

The author would like to thank Dr. A. Pigulski of Wrocław University Observatory for his help in the preparation of this paper.

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Table 1. Comparison of periods (in days).

Variable	*Source*	*P1*	*P2*	*Range*
AA Cyg	GCVS	212.7	—	9.4–12.4 p
	this study	208.8	—	8.5–10.6 vis
U Del	GCVS	110:	—	7.6–8.9 p
	Mizser *et al.* 1990	1150	182	5.6–7.5 vis
	Schult and Lehmann 1990	1160	710	—
	Percy *et al.* 1993	1133	—	6.4–7.6 vis
	this study	1152	—	6.1–7.5 vis
RX Boo	Houk 1963	500	78:	—
	GCVS	340:	—	8.6–11.3 p
	this study	278	159.6	6.8–8.6 vis

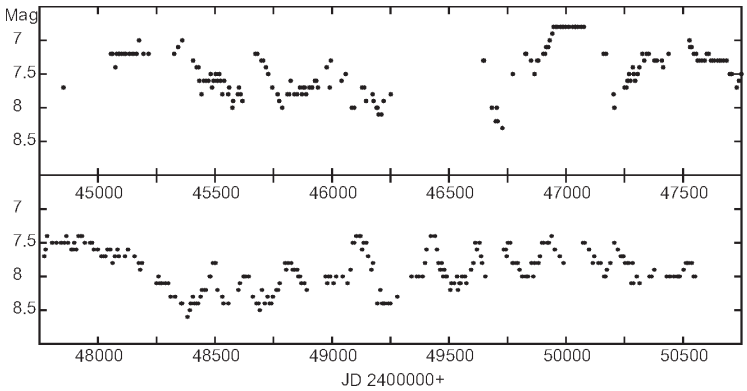

Figure 1. Visual light curve for RX Bootis, 1981–1997.

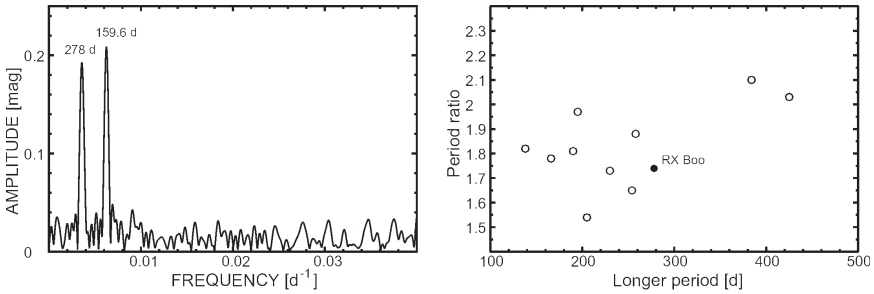

Figure 2. Left: RX Boo power spectrum for observations made since 1991. Right: Petersen diagram for double-mode SR variables.