

# RZ Cassiopeia: an Eclipsing Binary with a Pulsating Component

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**Abstract.** We report time-resolved *V*- and *R*-band CCD photometry of the eclipsing binary RZ Cas obtained with 38-cm Cassegrain telescope at the Crimean Astrophysical Observatory during July 2004 – October 2005. The obtained lightcurves clearly demonstrates rapid pulsations with a period of about 22 min. A periodogram analysis of these oscillations is also reported. On 12 January, 2005 (JD 2453383) we observed rapid variability with higher amplitude ( $\sim 0^m.1$ ), that perhaps may be interpreted as a high-mass-transfer-rate event and inhomogeneity of the accretion stream. Follow-up observations (both photometric and spectroscopic) of RZ Cas are strictly desirable for more detailed study of such events.

**Keywords.** (stars:) binaries: eclipsing; stars: individual (RZ Cas, GSC 04317-01793, HD 17138); stars: mass loss; stars: oscillations; (stars: variables:) delta Scuti; stars: variables: other.

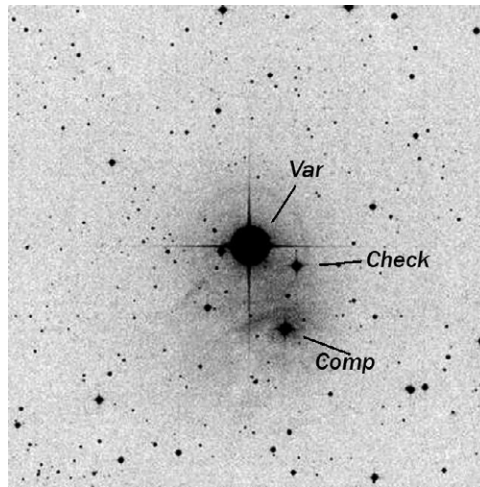
## 1. Introduction

The A3V+K0 IV eclipsing binary RZ Cas is an active semi-detached Algol system showing complex features in its lightcurve. It is well-known for demonstrating rapid pulsations ( $P \sim 22$  min) superimposed over its orbital eclipsing lightcurve. A brief overview of previous investigations of RZ Cas can be found in Golovin & Pavlenko (2006).

## 2. Observations

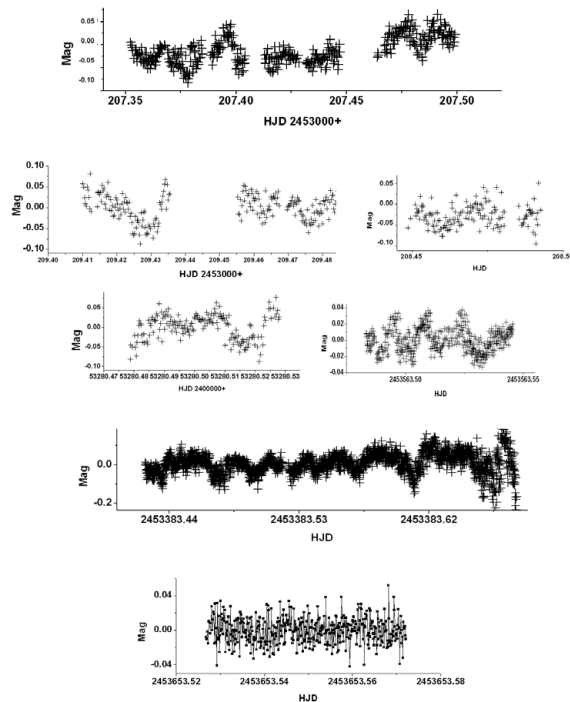
RZ Cas was observed in July 2004 – October 2005 in the *V* and *R* bands from the Crimean Astrophysical Observatory (Ukraine) by the authors, using a 38-cm Cassegrain telescope equipped with an SBIG ST-7 CCD camera, cooled by a Peltier system to about  $-20^\circ\text{C}$ . The field-of-view covered a sky region of  $12' \times 8'$  and the pixel size was  $0''.9 \times 0''.9$ . The exposure time was  $2^s.5$  for the *R* band and 5 or  $10^s$  for the *V* band. To minimize dead time we used binning by a factor of 2. Data reduction was done using the “Maxim DL” package. Reduction included bias, dark-frame subtraction and flat fielding using twilight sky exposures. Since the field of RZ Cas is not crowded, the technique of aperture photometry was applied to extract the differential magnitudes. The total number of useful frames was 4365. The brightness of RZ Cas was measured with respect to GSC 4317–1578 ( $\alpha = 02^\circ 48' 41''.58$ ;  $\delta = +69^\circ 35' 31''.3$ ;  $J2000.0$ ), while GSC 4317–1437 ( $\alpha = 02^\circ 48' 38''.29$ ;  $\delta = +69^\circ 37' 29''.9$ ;  $J2000.0$ ) served as a check star. Unfortunately, no suitable comparison and check star could be including in the frames

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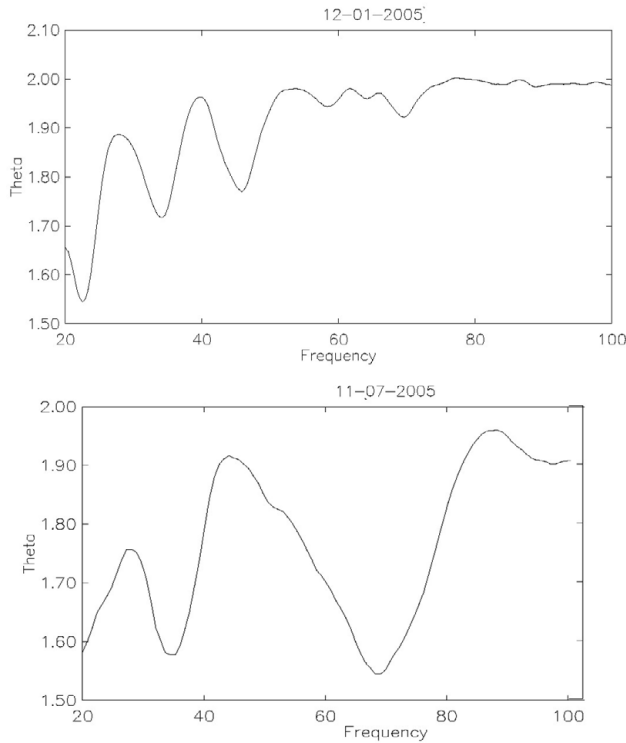


**Figure 1.** Finding chart.

(stars are at least  $4^m$  fainter than the variable star). The photometric error (determined from the difference *check star* – *comparison star*) is about  $0^m01$ . Figure 1 illustrates a  $15' \times 15'$  image of the RZ Cas region from DSS. Variable, comparison and check stars are marked.



**Figure 2.** Individual lightcurves.



**Figure 3.** Periodograms.

To rule out the possibility of observing variations caused by the comparison star, independent photometry of comparison star GSC 4317–1578 was performed with respect to check star GSC 4317–1437.

### 3. Discussion

Figure 2 shows brightness variations during the maximal part of the lightcurve. Separate observing runs are manifested. As could be seen, pulsation amplitude could be assumed to be about  $0^m.05$  on average. A great deal of interest was caused by the fact that on 12 January, 2005 (JD 2453383) we observed rapid variability with higher amplitude ( $\sim 0^m.1$ ), that perhaps may be interpreted as a high-mass-transfer-rate event and inhomogeneity of the accretion stream. Periodogram analysis (Figure 3) reveals the following periods: For 12, January, 2005 :

$$P_1 = 0.041895 \pm 0.000849 \quad (F_1 = 23.87 \pm 0.48)$$

$$P_2 = 0.021238 \pm 0.000218 \quad (F_2 = 47.08 \pm 0.48)$$

$$P_3 = 0.017470 \pm 0.000148 \quad (F_3 = 57.24 \pm 0.48)$$

$$P_4 = 0.014323 \pm 0.000099 \quad (F_4 = 69.82 \pm 0.48)$$

For all the other remaining nights:  $P_1 = 0.014489 \pm 0.000169$  ( $F_1 = 69.02 \pm 0.80$ ) — the period of pulsations of RZ Cas.  $P_2 = 0.028354 \pm 0.000646$  ( $F_2 = 35.27 \pm 0.80$ ) — almost twice the value of  $P_1$ .

#### 4. Conclusions

We report here photometric observations of RZ Cas'  $\delta$  Scuti-like pulsations. We stress attention to the abrupt increase in amplitude (up to  $\sim 0^m.1$ ) on 12 January, 2005 that perhaps may be interpreted as a high-mass-transfer-rate event and inhomogeneity of the accretion stream. Follow-up observations (both photometric and spectroscopic) of RZ Cas are strictly desirable for more detailed study of such events.

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