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DETECTION OF THE δ SCUTI OSCILLATION IN RZ CASSIOPEIAE

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We have observed the Algol-type binary system RZ Cas (A3V + K0IV) which has been known for the unusual changes of the shape of light curves at the bottom part of the primary minimum (*e.g.* Narusawa *et al.* 1994). We have carried out photometric observations to study “quasi-periodic oscillations” with a period of about 25 min and an amplitude of ± 0.04 magnitude reported by Davis and Balonek (1996) and Davis (1996). Such an oscillation has been found in an earlier time by Olson (1982).

The observations were carried out at four sites as shown in Table 1 with PMT photometers and a CCD camera. The observational journals are summarized in Table 2. In earlier PMT photometry, we used HR 791=HD 17929=HIP 12821 as a comparison star, until we noticed that the variability of this star is described in the Hipparcos/Tycho Catalogue (Perryman, 1997). The catalogued period and amplitude are 1^d.26819 and 0^m.01. In the latter observations HD 15784 was used as a comparison star. There is no description of the variability in the HD 15784 in the Hipparcos/Tycho Catalogue. Even though in the earlier observations, there should be no serious problem to use HR 791 as a comparison star, because we studied the variability on the time scale of 0.01 - 0.02 d which is very short compared with that of the variability for HR 719. In the CCD photometry, we use SAO12413=Tyc4316-00097-1 and HD 16615=HIP 12734 as the comparison and the check star respectively. There are no descriptions of variability on these stars in Hipparcos/Tycho catalogue.

In our all observational data obtained on the photometric nights, we have detected the periodic oscillations with the amplitude of twenty mmag. In Fig. 1, the oscillation in RZ Cas at a primary minimum in *B*-band, a secondary minimum in *R*-band and an out-of-eclipse in *B*-band are shown. All light curves indicated here are corrected for the mean light curves. The correction is performed in the intensity scale. In the primary

minimum, in order to separate the short-term variability from the light variation caused by the eclipse, we subtract the mean light curve from observed light curve. The mean light curve we used is the 4th order polynomial fitted by the least-squares method to the data produced by folding the observations at the minimum.

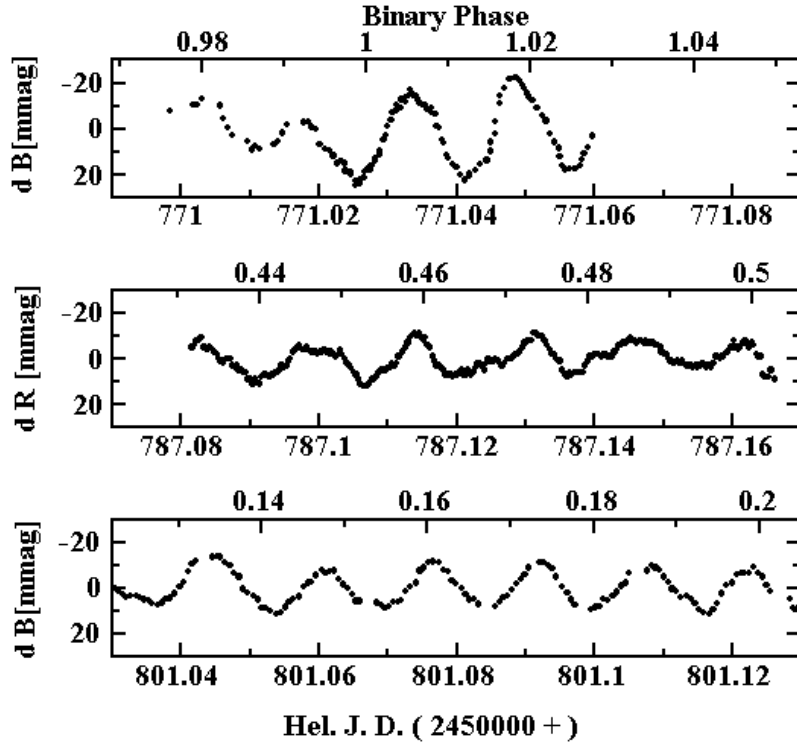


Figure 1. Observed oscillations at various binary phases of RZ Cas. Upper, middle and lower light curves obtained at a primary minimum in B-band, a secondary minimum in R-band and an out-of-eclipse in B-band respectively

We adapted the PDM analysis (Widjaya, 1996) to B-band photometric data with a time span of 83 days. In Fig. 2, the relative variance of data set, theta, is illustrated in the upper subfigure. The periodicity is found at the period of 0^d.0155766 (frequency = 64^d.199⁻¹) and 0^d.0157812 (63^d.367⁻¹) with multi-periodic feature. The detailed analysis of light curve should be performed more carefully. In the lower subfigure, the five-point running averaged magnitudes are plotted with the phase. Since the spectral type of the primary is A3V, we can see the star is in the bluest group of known δ Scuti stars and also included in the theoretical instability strip for the δ Scuti stars (*e.g.* see Moskalik 1995). The period of 0^d.016 is not typical one of the δ Scuti stars, but is not too short because the periods of the shortest known δ Scuti stars are 0^d.0205 and 0^d.03 for V624 Tau and V377 Cas, besides 0^d.0084 for a suspected member of the group V816 Cen. We conclude that the oscillations in RZ Cas we detected are the δ Scuti variability and that RZ Cas may be the shortest period star in the known δ Scuti stars. The relation between amplitude and color variations in the oscillation of RZ Cas shown in Fig. 11 of Olson (1982) justly indicates the character of the δ Scuti oscillation.

We suppose that the temporal changes of the shape of light curves during the primary

Table 1: Observational Sites

Site	Observer	Telescope ¹	Detector ²	Integ. Time
Funao	Akazawa	0.28-m S.C.	PMT R647p P.C.	10 sec.
Senoh	Ohkura	0.35-m S.C.	PMT R647p P.C.	10 sec.
BAO	Kawabata	1.01-m Cass.	PMT R647p P.C.	10 sec.
FBO	Fujii	0.075-m refractor	CCD ST-7	10/20 sec.

¹ S. C. : Schmidt-Cassegrain telescope

² P. C. : photon-counting system

Table 2: Observational Log

Start time (Hel. J. D.)	Binary Phase Coverage	Band	Comparison Star	Site
2450747.100	0.981 - 0.026	<i>B,V</i>	HR791	Funao
2450753.054	0.963 - 0.016	<i>B,V</i>	HR791	Senoh
2450753.093	0.995 - 0.010	<i>B,V</i>	HR791	Funao
2450753.264	0.139 - 0.196	<i>B,V</i>	HR791	Funao
2450759.055	0.984 - 0.015	<i>B,V</i>	HR791	Senoh
2450759.077	0.002 - 0.021	<i>B,V</i>	HR791	Funao
2450770.997	0.975 - 0.029	<i>B,V</i>	HR791	Senoh
2450771.008	0.985 - 0.015	<i>R</i>	HD12413	FBO
2450771.024	0.998 - 0.026	<i>B,V</i>	HR791	Funao
2450776.987	0.986 - 0.024	<i>B,V</i>	HR791	Funao
2450776.992	0.991 - 0.022	<i>B,V</i>	HR791	Senoh
2450786.163	0.663 - 0.721	<i>B,V</i>	HR791	Senoh
2450787.078	0.429 - 0.502	<i>R</i>	HD12413	FBO
2450788.042	0.235 - 0.244	<i>B,V</i>	HD15784	Funao
2450788.078	0.266 - 0.321	<i>B,V</i>	HD15784	Senoh
2450793.038	0.415 - 0.510	<i>B,V</i>	HD15784	Funao
2450793.047	0.423 - 0.518	<i>B,V</i>	HD15784	Senoh
2450800.945	0.031 - 0.281	<i>R</i>	HD12413	FBO
2450801.048	0.117 - 0.230	<i>B,V</i>	HD15784	Funao
2450801.055	0.123 - 0.181	<i>V</i>	HD15784	BAO
2450805.998	0.259 - 0.319	<i>B,V</i>	HD15784	Funao
2450806.025	0.281 - 0.366	<i>B,V</i>	HD15784	Senoh
2450807.024	0.117 - 0.217	<i>B,V</i>	HD15784	Senoh
2450808.000	0.934 - 0.011	<i>B,V</i>	HD15784	Funao
2450808.005	0.937 - 0.060	<i>U,B,V</i>	HD15784	Senoh
2450825.975	0.972 - 0.033	<i>B,V</i>	HD15784	Senoh
2450829.970	0.392 - 0.374	<i>B,V</i>	HD15784	Funao
2450830.063	0.314 - 0.515	<i>B,V</i>	HD15784	Senoh

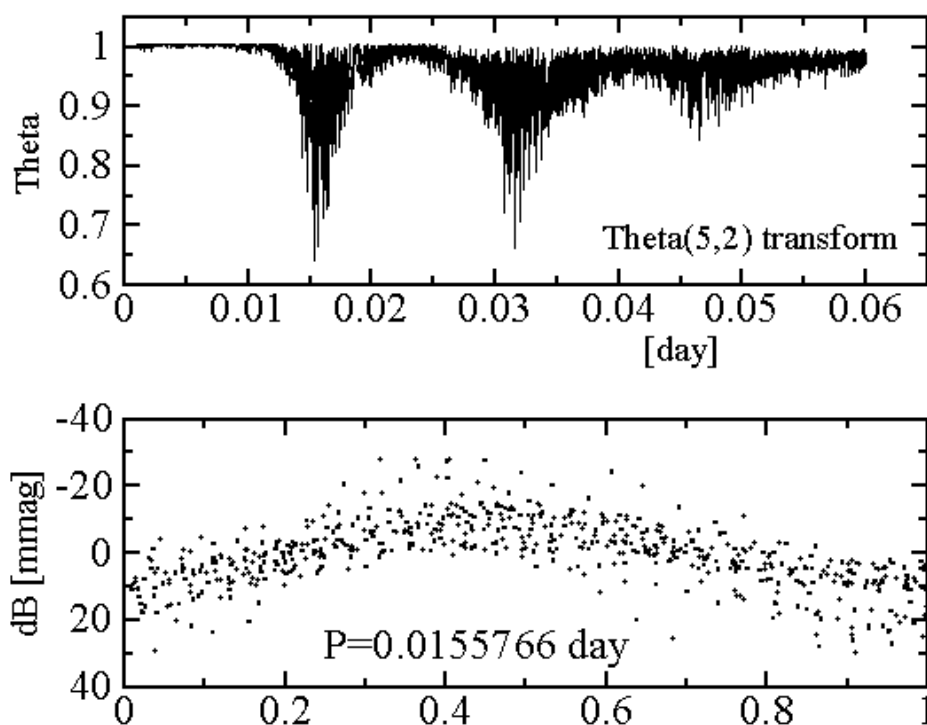


Figure 2. a) The relative variance, Theta, for all B-band observations derived from the PDM analysis. The periodicity is found at 0.0155766 and 0^d0157812 with multi-periodic feature. b) The five-point running mean values plotted with one of the most dominant period, 0^d00155766

minima were caused from the superposition of the delta Scuti type oscillation of the A3 component. Detailed analysis of the light curve will be published elsewhere.

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