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THE 1994 SUPEROUTBURST OF RZ SAGITTAE

RZ Sge has been known as an SU UMa-type dwarf nova since the discovery of superhumps during the 1981 superoutburst (Bond et al. 1982). Since no further photometric study of this object has been published so far, we undertook time-resolved CCD photometry during the 1994 August superoutburst in order to refine our knowledge on this object.

Observations were carried out using a CCD camera (Thomson 7882, 576 × 384 pixels) attached to the Cassegrain focus of the 60-cm reflector (focal length = 4.8 m) at Ouda Station, Kyoto University (Ohtani et al. 1992). To reduce the readout dead time, an on-chip summation of 2×2 to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time was between 40 and 100 s depending on the brightness of the object; the read-out and data-saving time was typically 13 s. A total of 725 useful object frames were obtained on 6 nights between 1994 August 11 and 18.

Table 1. Journal of observations of RZ Sge

Date			Start		End		Exposure	Frames
			h	m	h	m	(s)	
1994	August	11	12	44	16	49	40	102
		12	10	21	15	12	40	168
		13	13	09	13	42	40	34
		14	10	22	13	25	40	205
		15	10	18	13	27	40	167
		18	13	21	14	55	100	49

These frames were, after corrections for standard de-biasing and flat fielding, processed by a microcomputer-based aperture photometry package developed by the author. The differential magnitudes of the variables were determined using the local standard star (C1 in Figure 1) whose magnitude was given as V=12.83 by Misselt 1996). A comparison of the local standard star with a check star (C2 in Figure 1) in the same field has confirmed the constancy of the standard during a run, and gives the expected standard error in the differential magnitudes for the variable as 0.01 mag for a single frame on ideal nights. Heliocentric corrections to the observed times were applied before the following analysis.

The overall light curve constructed from our observations is shown in Figure 2. The light curves shows a slow linear decline with a rate of 0.097 mag day^{-1}, characteristic to a superoutburst of an SU UMa-type dwarf nova, followed by a rapid decline on August 18. Detailed light curves on individual nights are shown in Figure 3, clearly demonstrating the existence of superhumps with amplitudes of 0.20 – 0.25 mag, and recurring every 0.070 day. The amplitude of superhumps seem to have attained a maximum on August 14, four days before the termination of the superoutburst. Such a late growth of superhumps may be related to a similar phenomenon observed in a large-amplitude SU UMa-type dwarf nova, V1028 Cyg (Baba et al., in preparation).

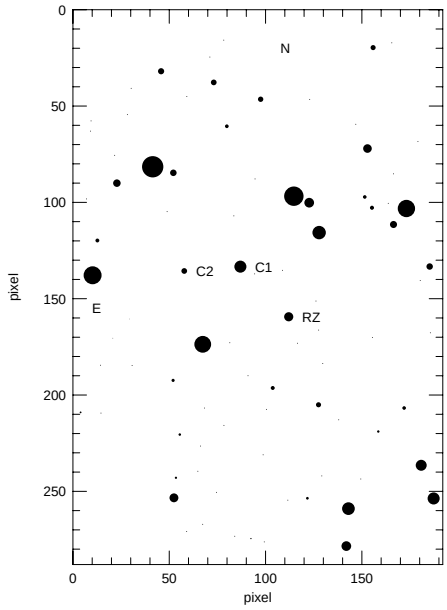

Figure 1. Finding chart of RZ Sge drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The comparison stars (C1, C2) and RZ Sge (RZ) are marked.

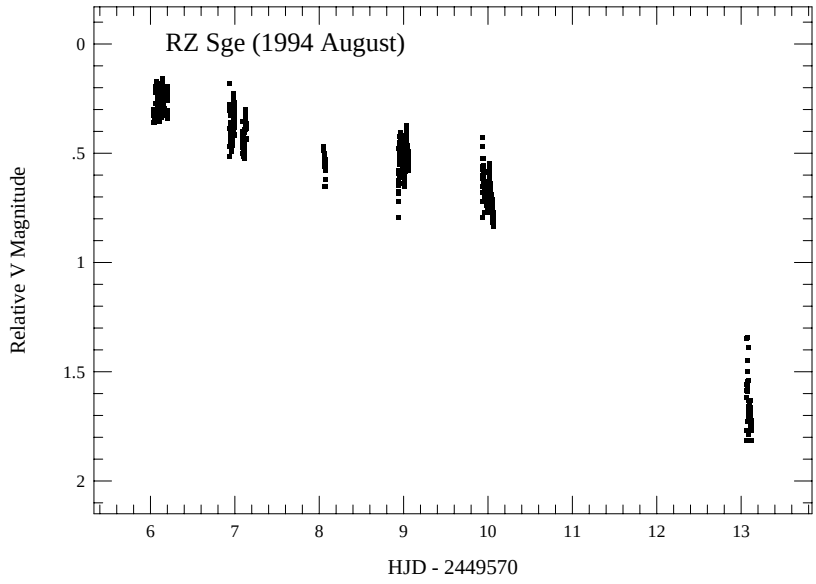

Figure 2. Overall *V*-band light curve of RZ Sge during the 1994 August superoutburst. The zero corresponds to V=12.83

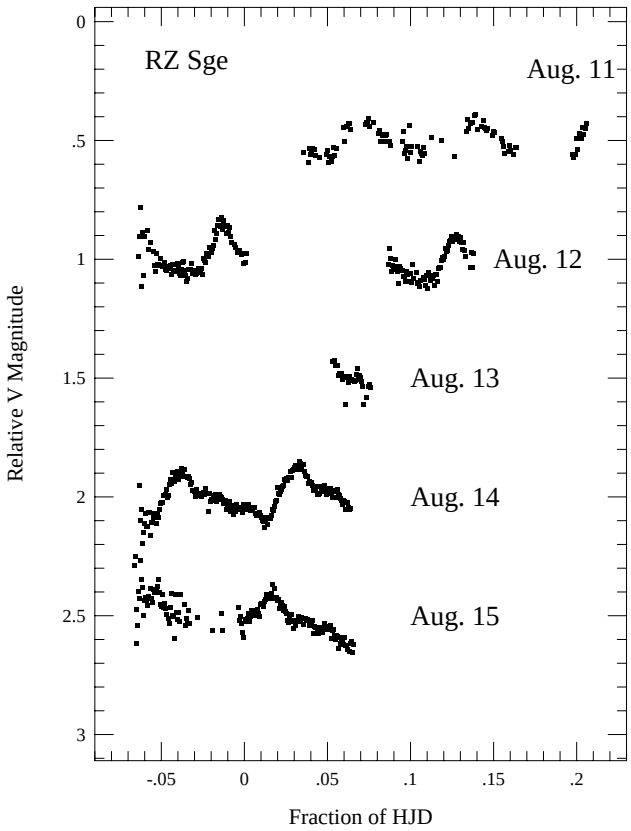

Figure 3. Detailed V-band light curves of RZ Sge. Each light curve is offset by 0.5 mag

After removing a linear trend of decline, a period analysis was applied to observations using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978) for the August 11 – 15 data. The resultant theta-diagram is shown in Figure 4. The lowest minimum at a frequency of 14.200 day^{-1} corresponds to a period of 0.07042 $\pm$ 0.00002 day (=101.4 min), giving a slightly longer period than published by Bond et al. (1982). This value is slightly different from that determined by the maxima times of superhumps (cf. Table 2, caption). This is because the PDM uses data points distributed in all phases whereas maxima times rely only on points around maxima. The periods determined using these two methods may be systematically different when the profile of (semi-)periodic signals varies, as is usual for superhumps. We have adopted the PDM value since this method usually gives better statistics than the other.

Table 2. Observed superhump maxima of RZ Sge. O$-$C$_1$ and O$-$C$_2$ are calculated by equations of $Max(HJD) = 2449576.986 + 0.07053E$ and $Max(HJD) = 2449576.985 + 0.07081E - 7.0 \times 10^{-6}E^2$, respectively

HJD	E	O$-$C$_1$	O$-$C$_2$
2449576.985	0	-0.001	0.000
49577.127	2	0.000	0.000
49578.962	28	0.001	0.000
49579.033	29	0.002	0.000
49580.017	43	-0.002	0.000

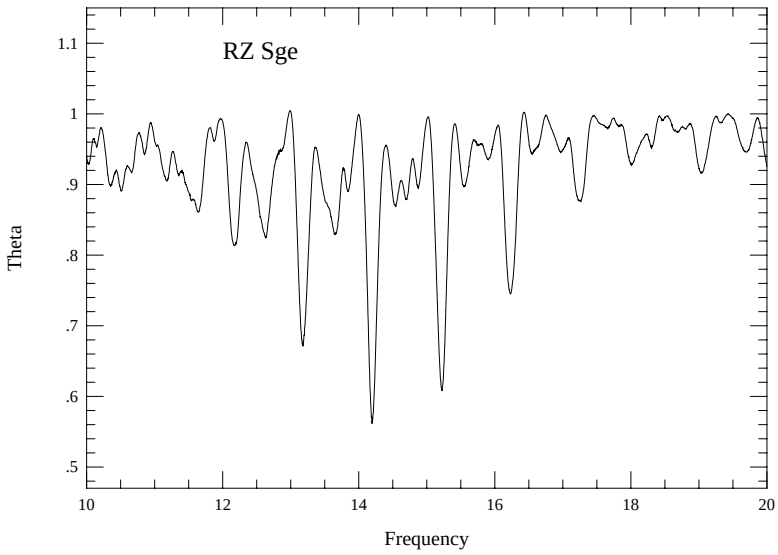

Figure 4. Theta diagram (Stellingwerf 1978) of period analysis

By applying least-squares fitting to five well-observed maxima times of superhumps, we obtained the following ephemeris of maxima times:

$$Max(HJD) = 2449576.985 + 0.07081E - 7.0 \times 10^{-6}E^2,$$

which corresponds to $\dot{P}$ of $-10(\pm 2) \times 10^{-5}$. This value is within the usual range of period changes of superhumps in SU UMa-type dwarf novae (Patterson et al. 1993).

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