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# THE SU UMa NATURE OF V630 CYGNI

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V630 Cyg was discovered and designated as S 4556 by Hoffmeister (1949). Romano (1966) observed this star and found that V630 Cyg shows frequent short and long outbursts, which is very suggestive of an SU UMa-type dwarf nova. Then, the star has been regularly monitored as a candidate SU UMa-type dwarf nova by a number of amateur observers. Wenzel (1989) also detected apparent superoutbursts. Bruch & Schimpke (1992) obtained an optical spectrum with the weak Balmer emission lines which does not well agree with the normal behavior of SU UMa stars. Cordova et al. (1981) reported that V630 Cyg was not detected during a survey with *HEAO-1* in soft X-rays. Nogami et al. (1997) measured that the recurrence cycle of long outburst is 290 d and that of short outburst is 30–50 d.

Table 1: The observation summary

| Date | HJD start[1] | HJD end[1] | Exposure time (s) | Error[2] | Mean $V$ mag[3] | $N$[4] |
|---|---|---|---|---|---|---|
| 17 August, 1996 | 50313.054 | 50313.060 | 90 | 0.01 | 2.419 | 5 |
| 18 | 50313.958 | 50314.086 | 90 | 0.02 | 2.531 | 112 |
| 19 | 50315.187 | 50315.293 | 90 | 0.02 | 2.719 | 93 |
| 20 | 50316.209 | 50316.297 | 90 | 0.04 | 2.911 | 72 |
| 21 | 50317.217 | 50317.222 | 60 | 0.03 | 4.035 | 5 |
| 5 September, 1996 | 50332.097 | 50332.103 | 90 | 0.25 | 5.949 | 5 |
| 10 July, 1999 | 51370.497 | 51370.579 | 30 | 0.05 | 2.559 | 200 |
| 11 | 51371.466 | 51371.549 | 30 | 0.05 | 2.647 | 200 |
| 12 | 51372.470 | 51372.552 | 30 | 0.07 | 2.739 | 199 |

[1] HJD − 2400000
[2] Nominal error for each point
[3] Magnitude relative to the local standard star GSC 0318701786 (GSC mag = 12.18)
[4] Number of frames

To investigate the nature of V630 Cyg, we carried out time-resolved photometry during outbursts caught by P. Skalak (Vanmunster 1996) in 1996 and by Poyner (1999) in 1999.

In 1996, we performed the observations at Ouda Station, Kyoto University. A 60-cm reflector (focal length = 4.8 m) and a Thomson TH 7882 CCD camera with a Johnson-$V$ filter attached to the Cassegrain focus were used (for more information of the instruments, see Ohtani et al. 1992). In 1999, the observations were carried out at the Conder Brow Observatory using an unfiltered CCD camera (SXL8) and a 33-cm Newtonian telescope. Table 1 gives the journal of the observations.

After standard de-biasing and flat fielding, the Ouda frames were processed by a microcomputer-based aperture photometry package developed by one of the authors (TK). The software used to reduce the raw Conder Brow data was developed by Nick James in England and performed standard de-biasing and flat fielding prior to processing using an aperture-based photometry programme. Magnitudes of V630 Cyg were measured relative to the local comparison star GSC 0318701786 (GSC mag = 12.18). The local check star GSC 0318700683 was used to confirm the constancy of the comparison within $0^{\rm m}.02$ during our observations and measure the nominal error for each data point.

Figure 1 shows the light curve of the 1996 August outburst. Since Skalak noticed this outburst on August 10 (HJD 2450306), the outburst lasted at least 11 days. Periodic modulations were clearly superposed on the slow decline trend (0.17 mag d$^{-1}$) between August 18 and 20. After removing the decline trend, we performed a period analysis by the phase dispersion minimization (PDM) method (Stellingwerf 1987). The best estimated period is 0.0789 ($\pm$ 0.0004) d (Figure 2a), and definite superhumps of this period is seen in Figure 2b, confirming the SU UMa nature of V630 Cyg.

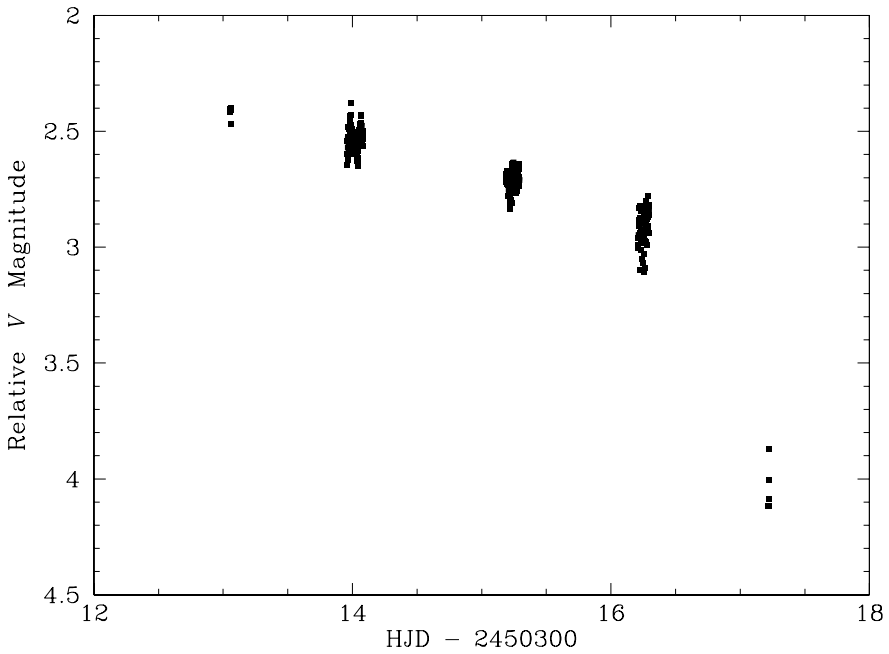


**Figure 1.** Light curve of the 1996 August outburst

V630 Cyg entered the rapid decline phase of the superoutburst and became fainter by $1^{\rm m}.1$ between our observations on August 20 and 21. Two weeks after, on September 5, the relative magnitude of V630 Cyg was $5.95 \pm 0.05$ mag, indicating that the amplitude of the superoutburst is larger than $3^{\rm m}.53$. This is a normal value of an SU UMa-type dwarf nova (see e.g. Nogami et al. 1997).

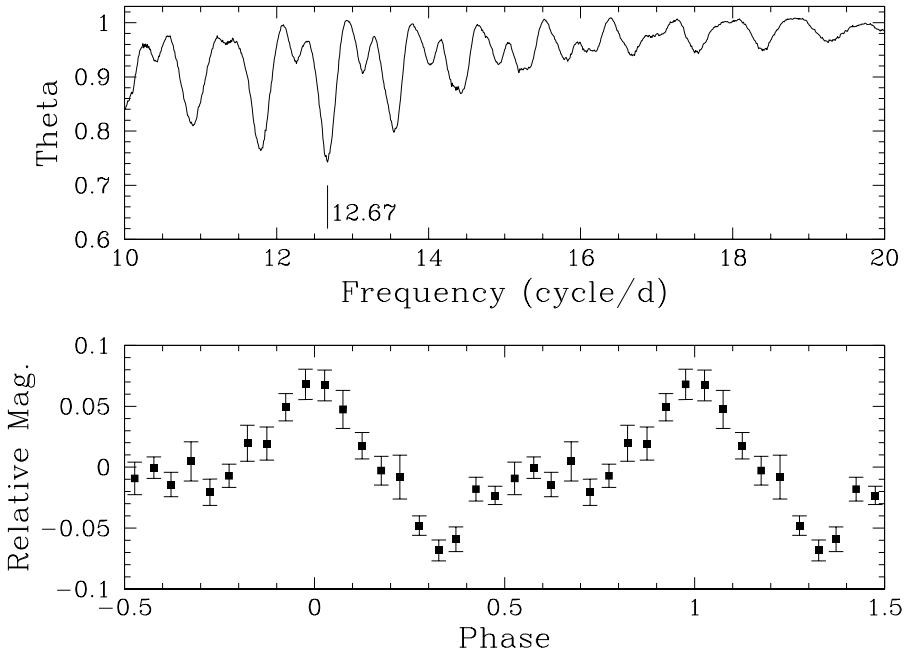


**Figure 2.** (upper panel, a) Theta diagram of the PDM analysis for the data between 1996 August 18 and 20, clearly indicating $f = 12.67 \pm 0.07$ d$^{-1}$ ($P = 0.0789 \pm 0.0004$ d) as the best estimated superhump period. (lower panel, b) Superhump light curve folded by the superhump period

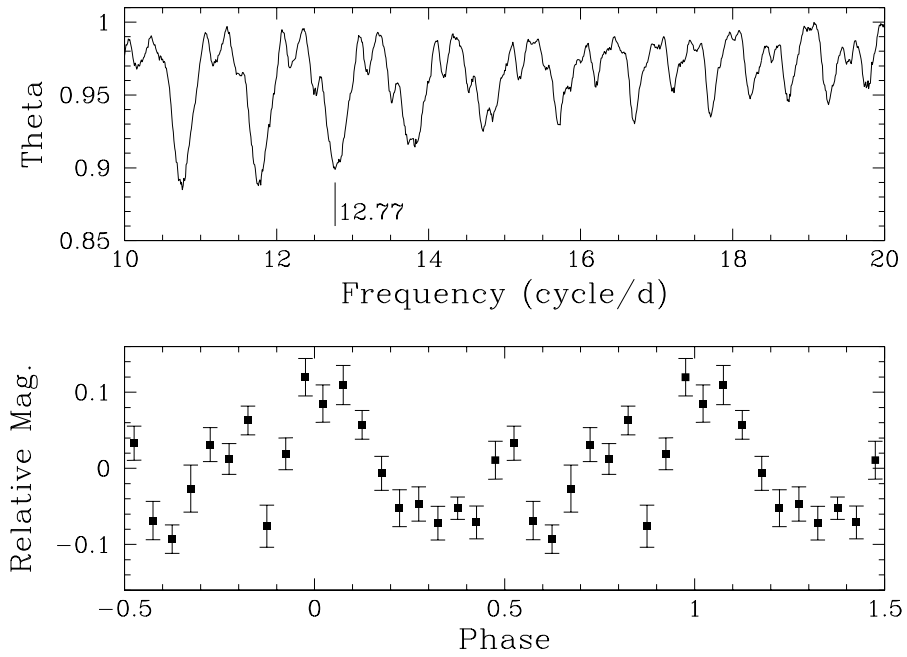


**Figure 3.** (upper panel, a) Theta diagram of the PDM analysis for the data obtained during the 1999 outburst. The best estimated period is $P = 0.0783 \pm 0.0008$ d ($f = 12.77 \pm 0.13$ d$^{-1}$), which is in accordance with the superhump period obtained in the 1996 outburst within the error. The other periods pointed by peaks with higher significance are rejected by manual period analysis. (lower panel, b) Superhump light curve folded by $P = 0\overset{\mathrm{d}}{.}0783$