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OBSERVATIONS OF SUPERHUMPS IN V1251 Cyg DURING THE 1991 SUPEROUTBURST

Variability V1251 Cyg was discovered by Weber (1966), who reported an outburst occurred in 1963. Rather rapid decline resembles that of a fast nova, but the nature and the identification in quiescent state has remained uncertain for a long time. Systematic visual monitoring of this variable star by amateur astronomers started in the 1980's. After a long series of negative observations, the star was finally caught in its second historical outburst by M. Moriyama on 1991 Oct. 25.54 UT at m_v=12.4 and by P. Schmeer on 1991 Oct. 26.833 UT at m_v=12.7 (Moriyama and Schmeer 1991, Korth 1991). The outburst was subsequently confirmed by CCD observation by the author on Oct. 28. The object was first observed in *BVI* bands. Its conspicuous blue color made the dwarf nova classification most likely.

Following this confirmation, the author obtained a time-resolved *V*-band CCD photometry of this object on eight nights between Oct. 28 and Nov. 15. The observations were carried out using a 60 cm reflector and a Thomson TH7882 chip (576×384 pixels) at Ouda Station, Department of Astronomy, Kyoto University (for a description of the instruments see Ohtani et al. 1992). The exposure time was between 20 and 120 s depending upon the brightness of the variable. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a microcomputer-based automatic-aperture photometry package developed by the author. The differential magnitudes of the variables were determined using a local standard star ($21^h40^m58^s.59 + 48°41'23''.1$ (J2000.0), V=10.1; the position and the magnitude from the Guide Star Catalog), whose constancy was confirmed using several check stars in the same field. The estimated error of single observation is 0.01 mag under favorable condition.

The overall light curve for the outburst is given in Figure 1, which shows a smooth slow decline followed by a rapid return to quiescence. From the time-resolved photometry, clear superhumps with a mean amplitude of 0.24 mag were detected on Nov. 3 (see Figure 2); this observation revealed the SU UMa-type nature of this object (Kato 1991). Twelve superhump maxima were observed between Nov. 3 and 6, and by linear regression of the superhump times, we could obtain a superhump period of 0.0759 day. A period analysis using the phase dispersion minimization (PDM) method (Stellingwerf 1978) after removing the steady decline yielded the best estimate of the superhump period of 0.07604 ± 0.00010 day. An examination of a rather fragmentary light curve on Oct. 28 could reveal only 0.05 mag variation (Figure 3), which could not fit the above superhump period. An examination of an image on Nov. 2 taken at the expected superhump maximum again failed to show a large amplitude ($\geq$ 0.1 mag) variation against the rest of the images taken on the same night. From these findings we concluded that the full development of the superhumps in this object took 4 – 7 days from the outburst maximum. This value is much longer than 2 – 3 days in typical SU UMa stars.

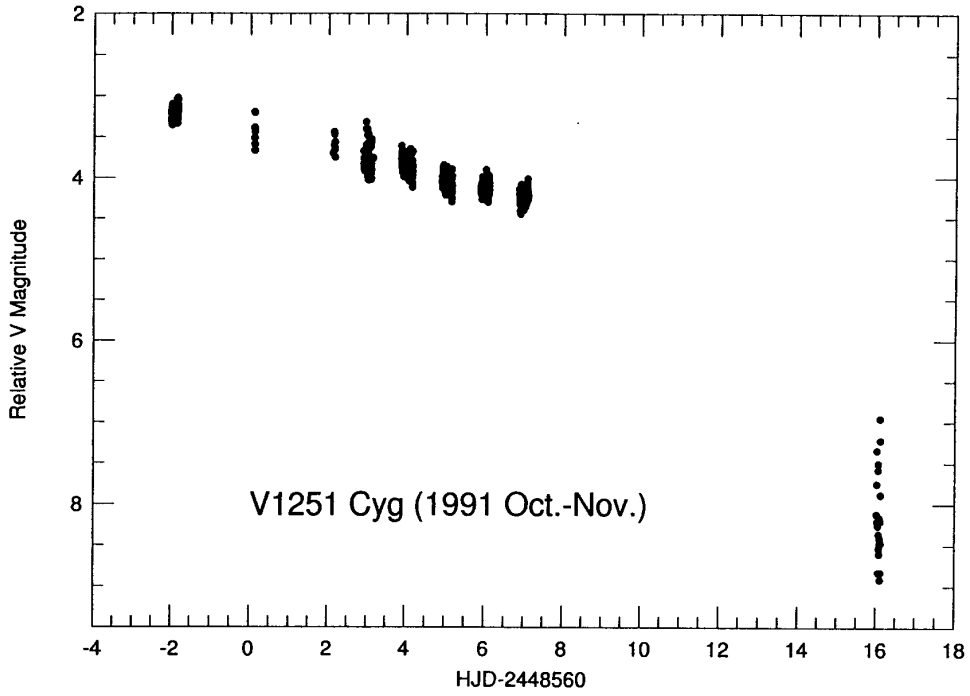

Figure. 1. General V-band light curve of V1251 Cyg. The zero point of the relative magnitudes corresponds to V=10.1.

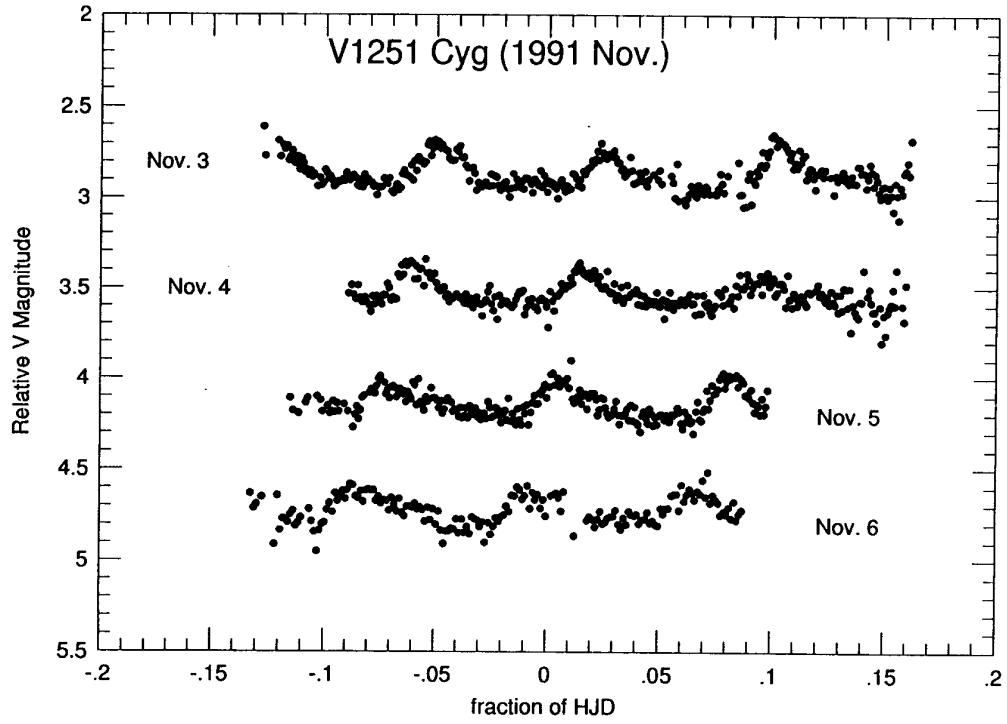

Figure. 2. Light curve for nights from Nov. 3 through Nov. 6. The magnitude is offset by 0.5 mag for each night. Superhumps are clearly seen.

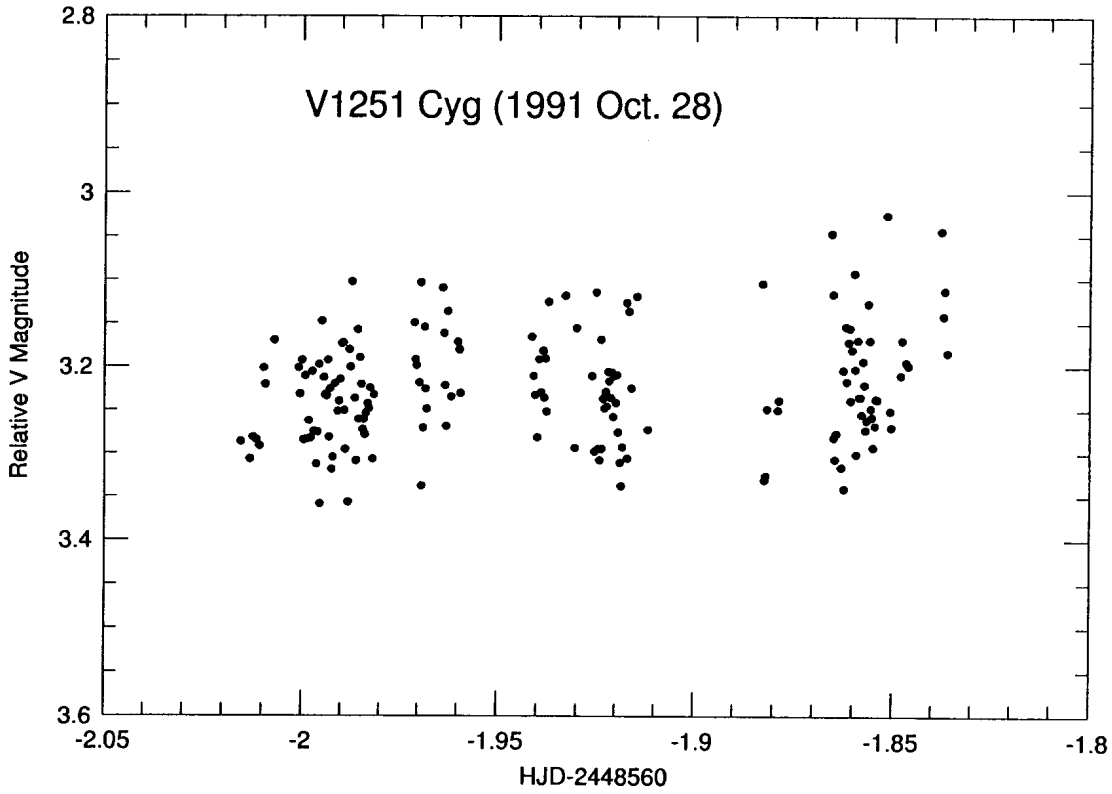

Figure. 3. Light curve on 1991 Oct. 28. Only a small amplitude ($\sim$ 0.05 mag) variation was present. The large scatter is due to the unfavorable sky condition.

The star has been monitored since, and was recorded again in superoutburst on 1994 Dec. 30 (Schmeer et al. 1995). Apparent absence of normal outbursts between these two superoutbursts, rarity of outbursts from a search in archival plates (Wenzel 1991), the long interval ($\geq$ 3 years) between the two successive superoutburst, a large outburst amplitude ($\sim$ 6.5 mag), and the slow development of superhumps all make V1251 Cyg a close relative of WZ Sge stars (Bailey 1979; Downes 1990) or TOADs (Tremendous Outburst Amplitude Dwarf Novae; Howell 1993). All the characteristics of V1251 Cyg most resemble those of SW UMa, despite the fact that V1251 Cyg has a much longer superhump period.

The author would like to point out one more peculiar feature in the light curve. Although one should be careful in comparing the visual and CCD magnitudes, the available material shows that this dwarf nova showed a rapid initial decline from m_v=12.4 (Oct. 25) to 13.3 (Oct. 28, this study). The similar feature can be also found in the light curve by Weber (1966). This feature would be explained, in the scheme of disk instability model, by the extra mass accumulated in the accretion disk during quiescence in the absence of normal outbursts (Osaki 1994), and would be a clue to understanding the peculiar outburst pattern of WZ Sge stars. A search for normal outbursts and detailed observations of V1251 Cyg both during outburst and quiescence are therefore highly encouraged.

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Taichi KATO
Dept. of Astron., Faculty of Sci.
Kyoto University
Sakyo-ku, Kyoto 606-01 Japan

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