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PREOUTBURST ACTIVITY OF V4641 Sgr = SAX J1819.3-2525: POSSIBLE EXISTENCE OF 2.5-DAY PERIOD

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Goranskij (1978, 1990) discovered an eruptive variable star in the close vicinity of the nominal position of Luyten's variable (HV 4048). [Goranskij's object once took over the GCVS nomenclature, GM Sgr, of HV 4048. However, recent studies (Morel 1999; Hazen 1999) suggest they are two independent variables. We use the new GCVS designation of 'V4641 Sgr' (Samus 1999) for Goranskij's object throughout this paper. Readers please pay special attention because several references already list the X-ray transient as 'GM Sgr'.] Goranskij (1978, 1990) reported a single short outburst in 1978 recorded on Moscow photographic plates, reaching $B = 12.4$. Goranskij (1990) also suggested the possible presence of a periodicity of 0.7365 day from the analysis of the quiescent data.

V4641 Sgr began receiving attention since this star was proposed as the possible optical counterpart of the faint flaring X-ray transient SAX J1819.3-2525 (in 't Zand and Heise 1999) based on the positional coincidence. The optical behavior of V4641 Sgr, however, was rather overlooked, until the discovery of a new optical outburst in 1999 August (Watanabe 1999). After a period of apparently increasing activity, the object went into a giant optical outburst reaching $m_{\rm V} = 8.8$ on 1999 September 15 (Stubbings 1999), which was followed by an intense X-ray flare (Smith et al. 1999).

In this paper, we report on the unusual optical activity prior this giant optical and X-ray outburst. The CCD observations were done using an unfiltered ST-7 camera attached to a 25-cm Schmidt-Cassegrain telescope at Kyoto University. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java$^{\rm TM}$-based aperture photometry package developed by one of the authors (TK). The magnitudes of V4641 Sgr were determined using the GSC 6848.3882 (Tycho $V = 9.30$, $B - V = +0.49$), whose constancy was confirmed by comparison with GSC 6848.3606. The estimated $R_{\rm C}$ magnitude 9.05 was used to calculate unfiltered CCD magnitudes of V4641 Sgr. The small difference of the reported color of V4641 Sgr (Goranskij 1990) and that of the comparison will make unfiltered CCD magnitudes a good approximation of $R_{\rm C}$ magnitude of the variable. Visual observations were made using 32-cm telescopes by Stubbings, Watanabe and Monard. All visual observations used the V-magnitude sequences. The comparison of quasi-simultaneous visual and CCD observations has confirmed the consistency between

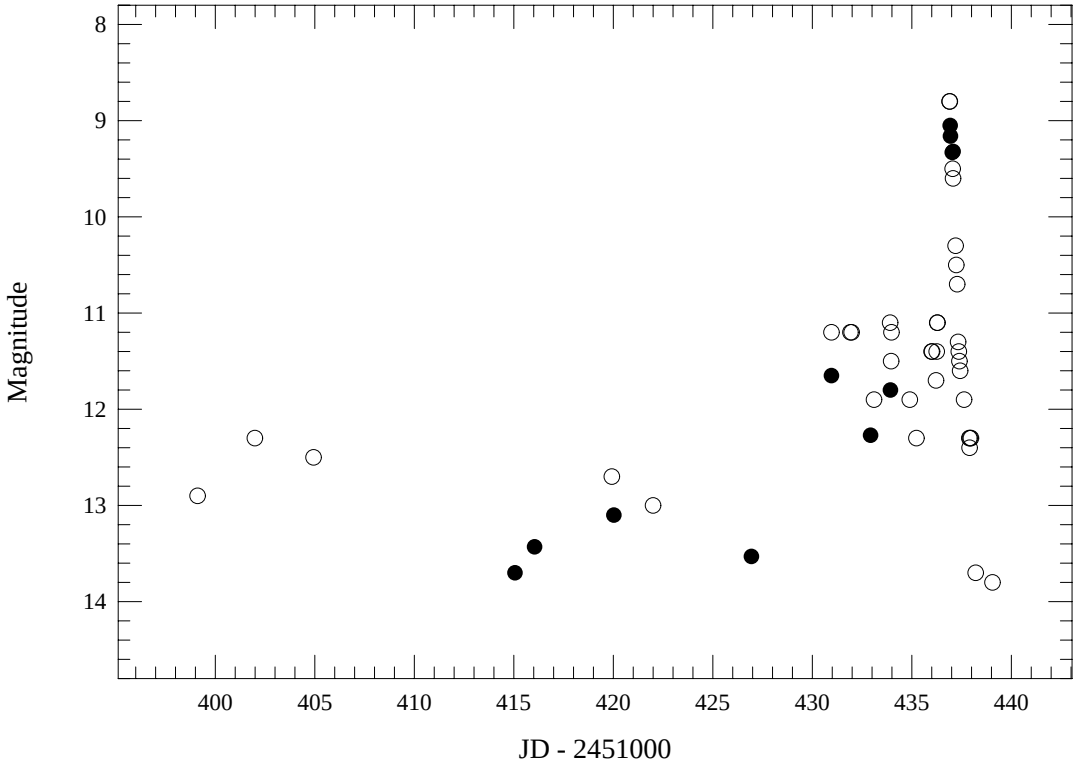

Figure 1. Light curve of V4641 Sgr

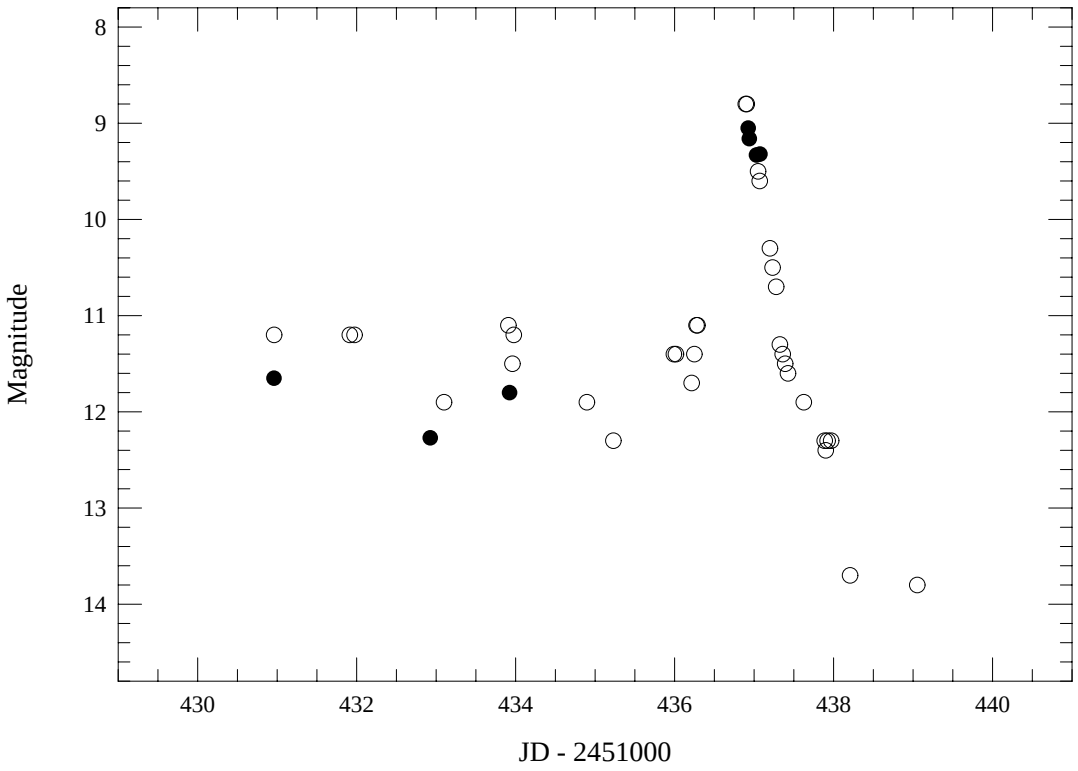

Figure 2. Enlarged light curve of V4641 Sgr showing quasi-periodic modulation prior to the giant outburst

visual and CCD measurements. The estimated error (0.1–0.2 mag) of visual estimates does not affect the following discussion.

Figure 1 represents the summary of present observation, including the later giant outburst for clarity. Filled and open circles represent CCD and visual observation, respectively. Some visual observations reported to VSNET have been supplemented for constructing the fading part of the outburst. V4641 Sgr rose gradually since the detection by Watanabe (1999). The most remarkable feature was the presence of high-amplitude modulation (Figure 2) since JD 2451431 (six days before the giant outburst). The modulation had an amplitude of $\sim$ 1 mag, with a quasi-period of 2.5 days. This periodicity does not fit any of candidate periods by Goranskij (1990). The observed periodicity can be either interpreted as arising from the modulation of the source activity, or as reflecting the underlying binary period. Since the examination of the RXTE monitoring of the galactic-center region has revealed that the X-ray from V4641 Sgr was already detected for this pre-outburst period (Markwardt et al. 1999), the optical modulation may have caused by the reflection effect by the X-ray heating on the secondary. In this interpretation, the 2.5-day period corresponds to the orbital period, which awaits confirmation by future radial velocity studies. Otherwise, the cause of previously unrecorded recurrent quasi-periodic brightening should be sought.

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