Discovery of Superhumps during a Normal Outburst of SU UMa

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Here we report on simultaneous g', Rc, and Ic photometry of SU UMa (a prototype of SU UMa-type dwarf novae) using OAO/MITSuME 50 cm telescope.

SU UMa-type dwarf novae are a subclass of dwarf novae. Their orbital periods range 1–2 hours. SU UMa-type dwarf novae show two types of outbursts. One is normal outburst, whose duration is about a few days. The other is superoutburst, whose duration is about two weeks. During the superoutburst, a tooth-like modulations called superhumps are observed. The superhump period is a few percent longer than the orbital period of the system. This is understood by phase-dependent tidal dissipation of a precessing accretion disk.

Long-term behavior of SU UMa-type dwarf novae are well explained within the framework of the thermal-tidal instability model [1]. According to this model, the radius of the accretion disk increases when a normal outburst occurs. When the radius of the accretion disk reaches the 3:1 resonance (at which the tidal instability sets in), a superoutburst is triggered. In other words, the radius of the accretion disk is below the 3:1 resonance radius outside the superoutburst.

Recently, [2] reported that superhumps are detected superhumps during a normal outburst just before the superoutburst. [3] further reported that superhumps persist during a normal outburst just after the superoutburst. These observations suggest that a reform of the thermal-tidal instability model is required.

In the present observations, we report on the detection of superhumps during an *isolated* normal outburst of SU UMa (see figure 1). Our result suggests that the radius of the accretion disk is already reaches the 3:1 resonance radius even in the middle of the cycle of the superoutbursts. Our result also raises a question why a superoutburst is suppressed, despite the accretion disk reaching the 3:1 resonance radius. This should be elucidated in future observations of other SU UMa-type dwarf novae.

More detailed discussion is given in the published letter [4].

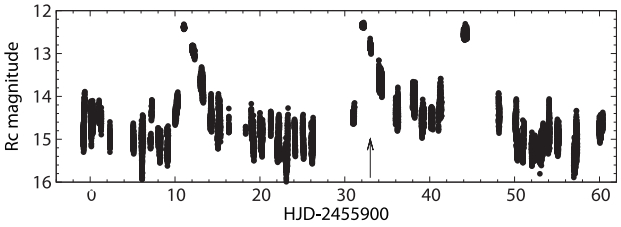

Figure 1: Rc band light curves of SU UMa. During the normal outburst marked with an arrow, we detected superhumps. This is the first case that superhumps are observed during an isolated normal outburst.

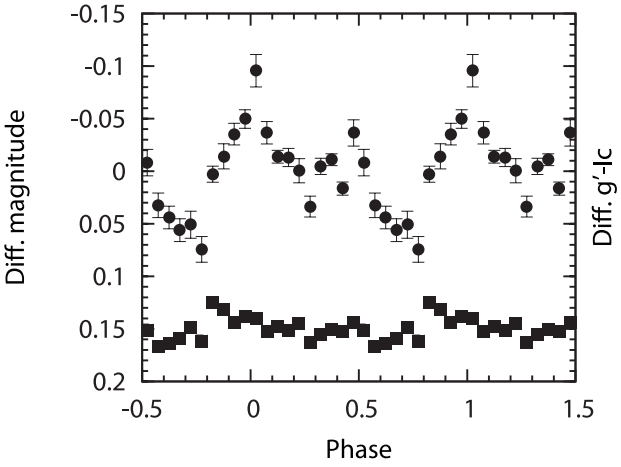

Figure 2: top: Phase-averaged Rc light curve folded with 0.07904 d. This periodicity is identical with that reported by [5]. bottom: g'-Ic color variations folded with the same period. A phase discordance between the magnitude and color is often observed during superhumps.

References

[1] Osaki, Y.: 1989, *PASJ*, **41**, 1005.
[2] Kato, T., et al.: 2011, *PASJ*, **64**, 21.
[3] Kato, T., et al.: 2013, *PASJ*, **65**, 23.
[4] Imada, A., et al.: 2012, *PASJ*, **64**, L5.
[5] Udalski, A.: 1990, *AJ*, **100**, 226.