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OBSERVATIONS OF 1993 SUPEROUTBURST OF TT Boo

Although first suspected to be a Z Cam-type dwarf nova in the third edition of GCVS, TT Boo has been a good candidate of SU UMa-type dwarf novae since discovery of possible superhumps with a period of 97 min by Thorstensen and Brownsberger in 1986 (cf. Howell and Szkody, 1988). Possible detection of 111-min modulation during quiescence was reported by Howell and Szkody (1988). This period was attributed to the possible orbital period, but apparent discordance with the reported superhump period should await further observations. Confirmatory observation of superhumps was further reported by Udalski (1991), but the period was not published. Despite its brightness at maximum ($m_v \sim 12\overset{m}{.}7$) and rather frequent outbursts, the system parameters of TT Boo remained poorly studied since. The author therefore undertook a series of CCD photometry during an apparent superoutburst in April 1993, in order to confirm the classification and to determine the accurate superhump period.

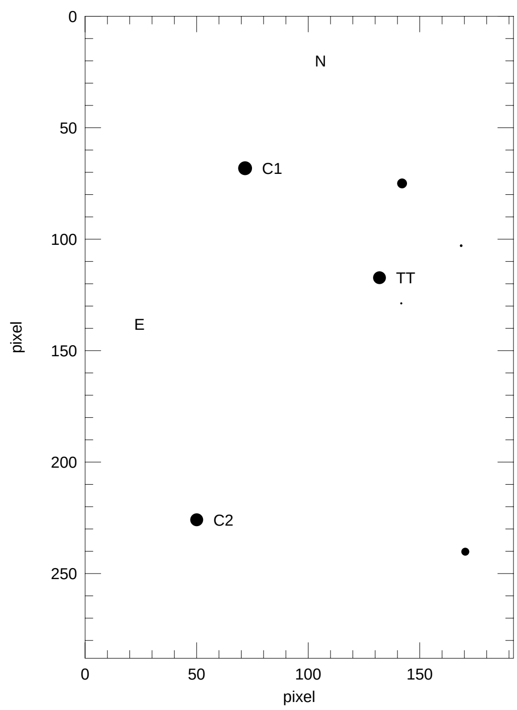

Figure 1. Finding chart of TT Boo drawn from a CCD image. North is up, and the field of view is about 10×7 arcmin. The primary comparison star (C1), check star (C2) and TT Boo (TT) are marked.

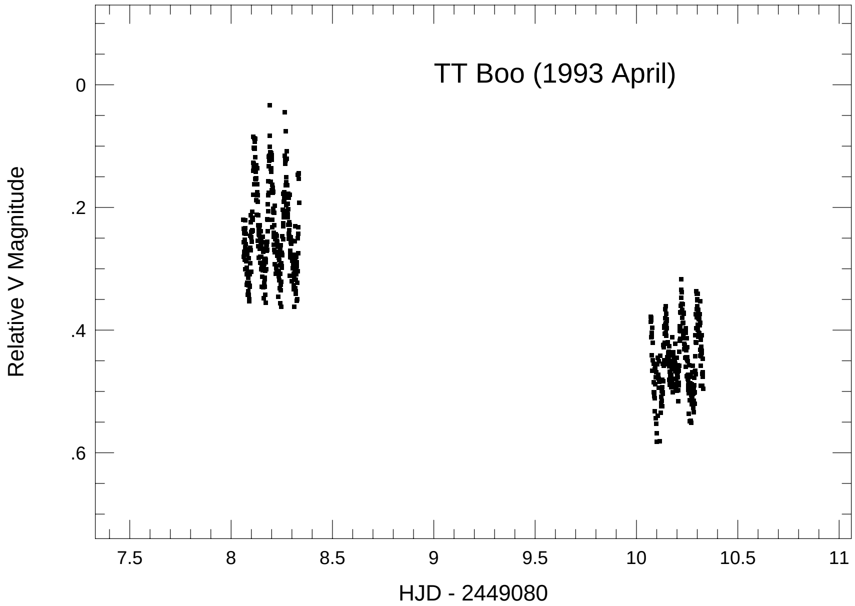

Figure 2. V-band light curve of TT Boo during a superoutburst in April 1993. The zero point of the magnitude scale corresponds to V=12.8.

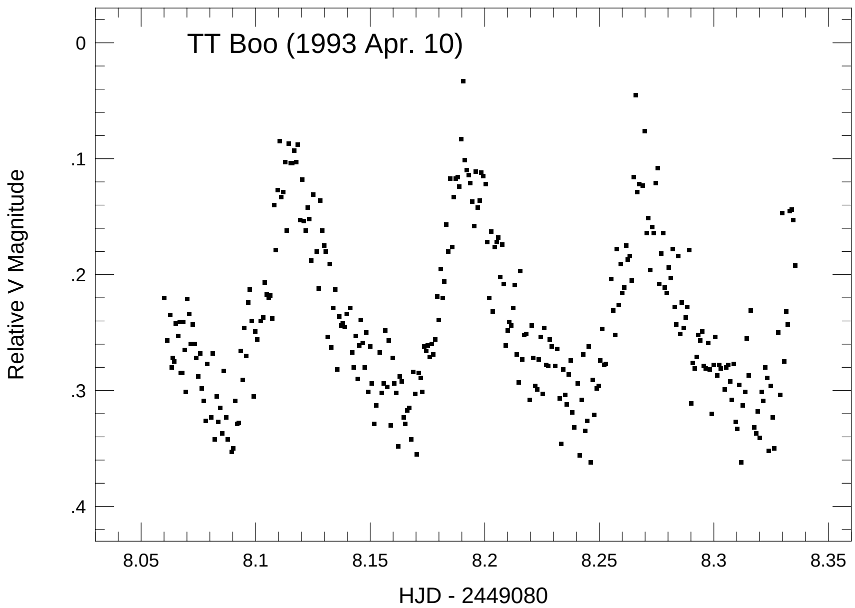

Figure 3. Enlarged light curve on April 10. Superhumps with an amplitude of 0.20 mag are clearly seen.

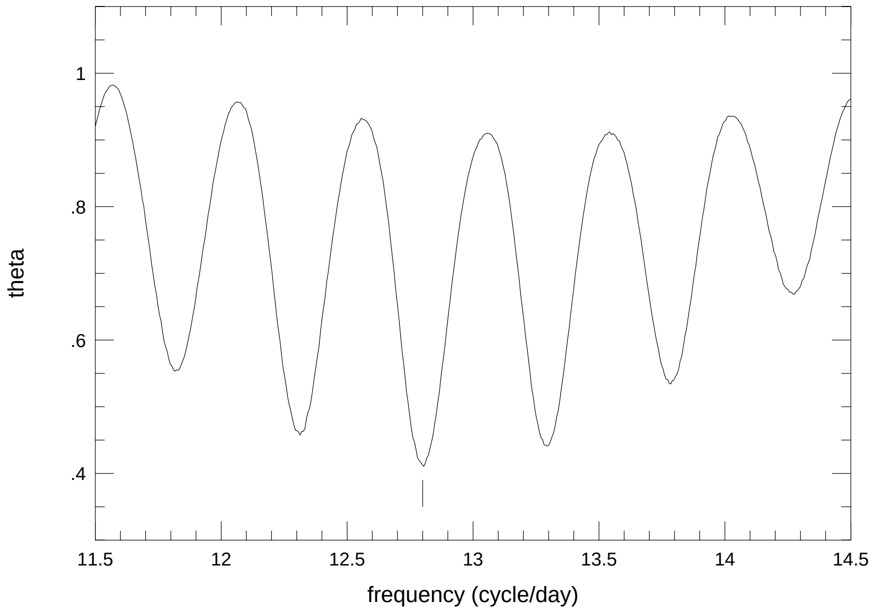

Figure 4. Theta diagram (Stellingwerf 1978) of period analysis for the whole data. A minimum at frequency 12.80 corresponds to the best superhump period of 0.07811 ± 0.00005 day.

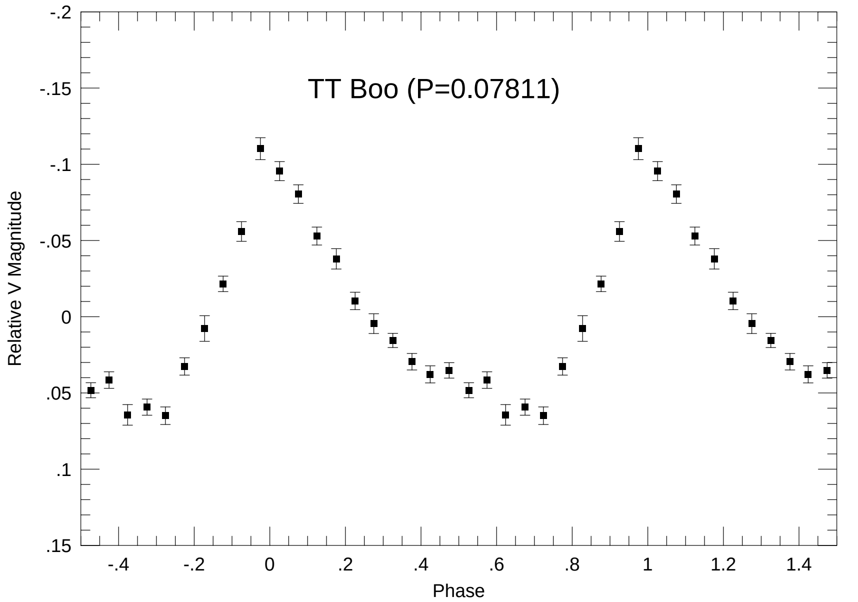

Figure 5. Folded superhump light curve of TT Boo. Each point represents 0.05 phase bin, and the vertical bar represents the standard error.

The observations were carried out using a CCD camera (Thomson TH 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 noise and dead time, an on-chip summation of 3×3 pixels to one pixel was adopted. An interference filter was used which had been designed to reproduce the Johnson V band. The exposure time of 60 s was adopted; the dead time between exposures was 9 s. The frames were first corrected for standard de-biasing and flat fielding, and were then processed by a personal-computer-based aperture photometry package developed by the author. The differential magnitudes of the variable were determined against a local standard star marked as C1 (V=12.8; Mattei, private communication) in Figure 1. 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 0.02 mag for a single frame. Total number of useful frames was 621.

The overall light curve is shown in Fig. 2. A slow decline with an averaged rate of 0.11 mag day^{-1} is characteristic of a superoutburst. A representative light curve obtained on Apr. 10 (Figure 3) clearly shows superhumps with an amplitude of 0.20 mag. After heliocentric correction and removal of a linear trend of decline, a period analysis was applied to the whole data set using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978). A theta diagram is shown in Figure 4. The resultant superhump period is 0.07811 ± 0.00005 day. A folded light curve (Figure 5) by this period clearly shows a profile of full-grown superhumps. TT Boo has thus become a member of SU UMa-type dwarf novae with well-determined superhump period.

The empirical relation of the orbital period and the superhump period in SU UMa-type dwarf novae (Howell and Hurst, 1994) expects the orbital period of this system as ~0.0748 day, which is significantly shorter than the photometric period obtained during quiescence. Accurate determination of the orbital period is therefore desired.

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