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SUPERHUMP IN NOVEMBER 2000 SUPEROUTBURST OF TY PISCIUM

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The SU UMa type dwarf nova TY Psc was found in bright state on 28 Nov 2000 by J. Ripero (vsnet-campaign 545:

http://www.kusastro.kyoto-u.ac.jp/vsnet/Mail/vsnet-campaign/msg00545.html

and vsnet-superoutburst 66:

http://www.kusastro.kyoto-u.ac.jp/vsnet/Mail/vsnet-superoutburst/msg00066.html).

It was then observed photometrically using small telescopes equipped with V filter, which resembles Johnson V filter and cooled CCD camera in three sites:

1. Kyoto University on October 30, 2000, using 25-cm Schmidt–Cassegrain, with ST-7 CCD camera.
2. Ouda Station, Kyoto University, on November 1, 2000, using 60-cm Cassegrain with PixelVision camera (SITe SI004AB, Cryo Tiger-cooled) and Rc filter.
3. Gunma Astronomical Observatory on November 3, 2000, using 25-cm Newtonian with cooled Bitran 11 CCD camera and V filter.

The exposure time was 30 seconds in Kyoto and Ouda, and around 25 to 40 seconds in GAO observation depending on the altitude of the object. Ouda data were reduced using IRAF APPHOT package. To correct for the readout noise, the object frames were subtracted by bias frames and for flat fielding we used twilight frames. GAO and Kyoto data were reduced by Java^{TM}-based aperture photometry package developed by one of the author (TK). The readout and thermal noise was removed by dark frame subtraction and flat fielding was done using twilight frames.

Due to unstable weather condition, some of the Kyoto and Ouda data has to be rejected. The criterion for the rejection was one of the following conditions: (1) the count of the comparison star drop to less than 25% of the average count or (2) the count is more than 25% of average count but dropped suddenly more than 25% of those in the previous frame. Figure 1 shows the resulting light curve, the ordinate is the magnitude of the star relative to a comparison star. The comparison star used for differential photometry in

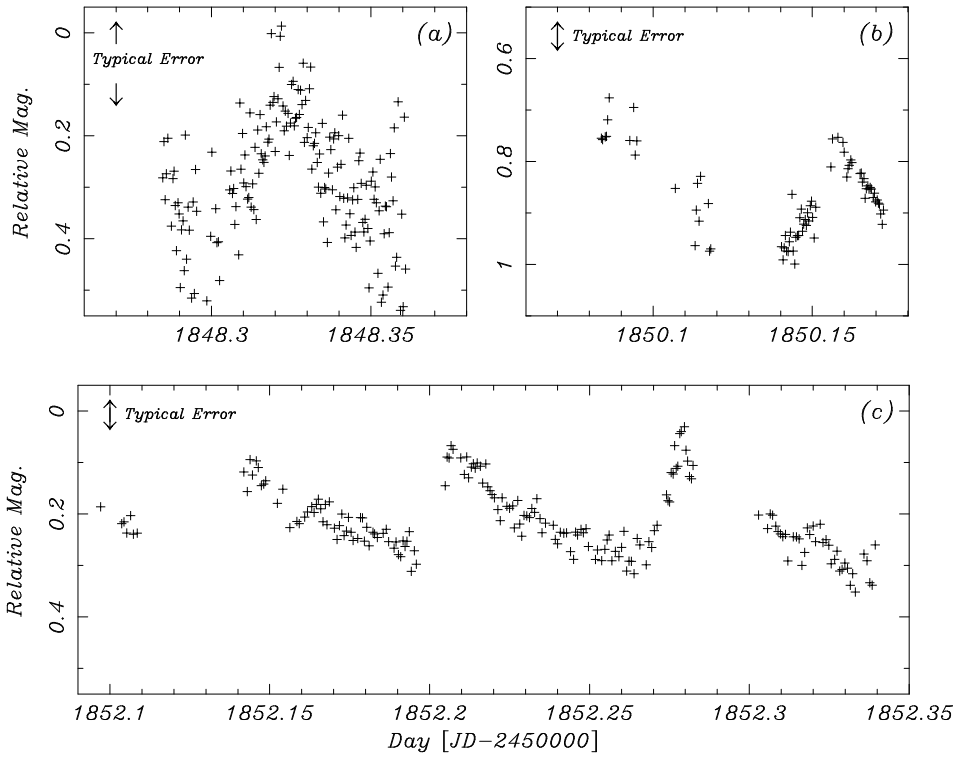

Figure 1. Light curves of TY Psc obtained at (a) Kyoto, (b) Ouda, and (c) Gunma

Ouda data is a $12\overset{m}{.}36$ star GSC 2296.1010, GAO and Kyoto data is a $12\overset{m}{.}49$ star GSC 2296.1213.

The trend of the data from each site was removed using straight-line fitting. The three sets of data were then combined to form one data set. Similar trend removal procedure was applied once again to the combined data to remove the influence of observational environment difference. The final combined and corrected data were then analyzed using Phase Dispersion Minimization method (Stellingwerf, 1978), which was implemented into PDMWIN 3.0 computer program wrote by Widjaja (1996). The resulting θ diagram is presented in Figure 2.

From Figure 2 we can estimate the most probable period, that is about 102 minutes. To get a more precise period determination we took part of Figure 2 that is the valley around 102 minutes period and fit it to a parabolic curve. The minimum of the parabola occurs at the trial period 0.0708 day or 101.9 minute. Using this value we construct the folded light curve and present in Figure 3. This graph shows a usual superhump light curve, that is a steeper brightening followed by slower dimming.

We used full width half maximum of the deepest valley of the θ diagram as the error of the period determination. Then the estimated error of the superhump period found is 0.4 minutes.

In this work we could confirm and refine previous superhump period estimation of TY Psc quoted by Szkody and Feinswog (1988). Despite unfavorable weather in two observation site, the period determination was relatively accurate. This is the consequence of long time covering (4 days) so that slight change in trial period will cause significant difference in θ (see Figure 2). Therefore long time covering is recommended for accurate determination of superhump period, provided there is no phase change between observations. Recalling the 98.4 minutes orbital period found by Thorstensen et al. (1996), this

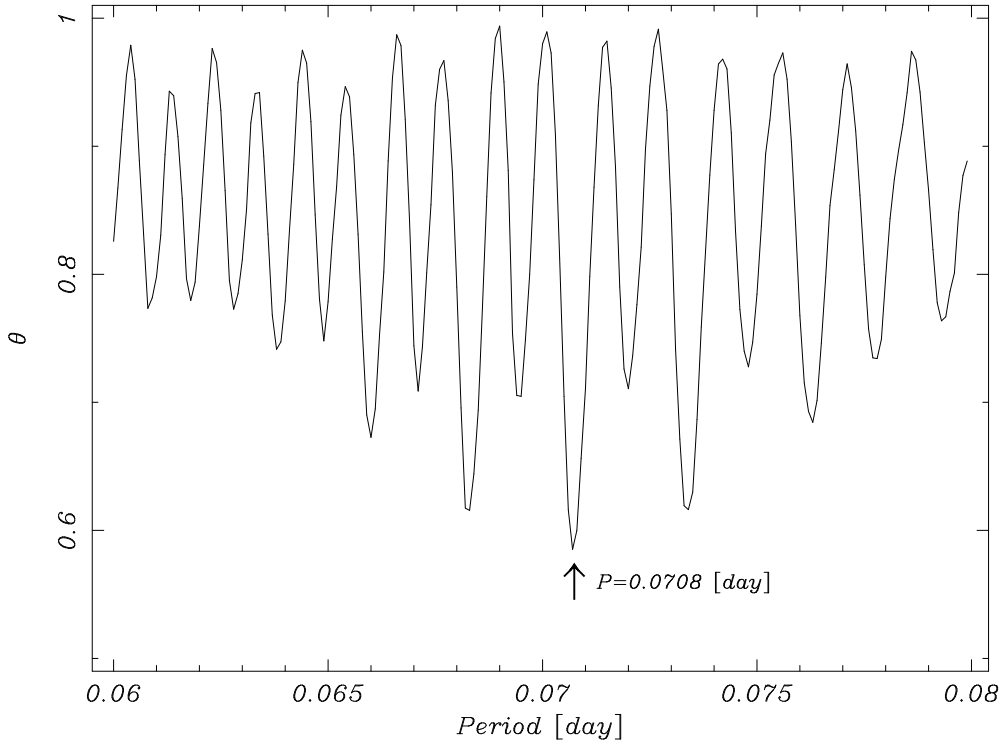

Figure 2. θ diagram of the period analysis of the combined data

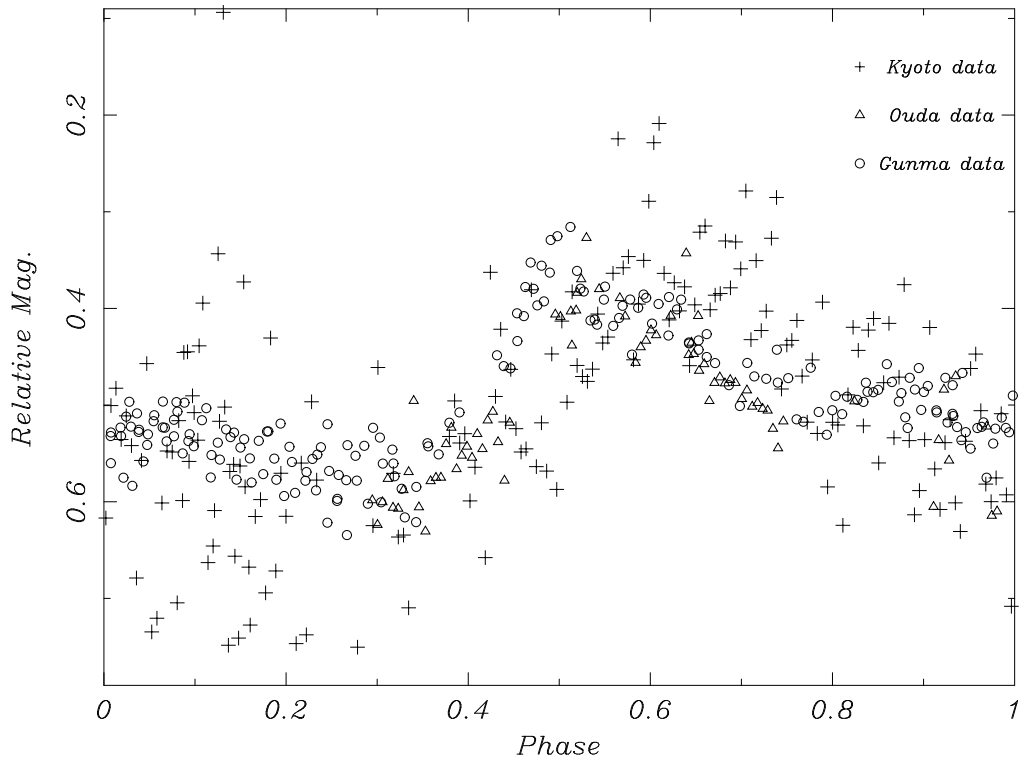

Figure 3. Folded curve of the combined data

superhump period is 3.6% longer than the orbital period which is quite normal for SU UMa type dwarf novae.

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