COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4794

Konkoly Observatory
Budapest
9 November 1999
HU ISSN 0374 – 0676

CCD PHOTOMETRY OF THE 1999 FEBRUARY SUPEROUTBURST OF CT Hya

T. KATO[1], S. KIYOTA[2], R. NOVÁK[3], K. MATSUMOTO[1]

[1] Dept. of Astronomy, Kyoto University, Kyoto 606-8502, Japan,
e-mail: tkato@kusastro.kyoto-u.ac.jp, katsura@kusastro.kyoto-u.ac.jp

[2] Variable Star Observers League in Japan, 1-401-810 Azuma, Tsukuba, 305-0031 Japan,
e-mail: skiyota@abr.affrc.go.jp

[3] Nicholas Copernicus Observatory, Kraví hora 2, Brno 616 00, Czech Republic,
e-mail: rudolfn@physics.muni.cz

CT Hya was discovered as a dwarf nova by Hoffmeister (1936). The SU UMa-type nature of this dwarf nova was first revealed by Nogami et al. (1996), who discovered superhumps with a period of $0\overset{d}{.}06505$, although there remained some ambiguity in the alias selection. Nogami et al. (1996) suggested that CT Hya is an intermediate object between ordinary SU UMa stars and WZ Sge stars. Upon the alert of a bright outburst on 1999 February 14 (R. Stubbings, VSNET), we undertook a time-resolved CCD photometry campaign. Table 1 summarizes the observation runs.

The observations at Kyoto were done using an unfiltered ST-7 camera attached to the Meade 25-cm Schmidt-Cassegrain telescope. The exposure time was 30 s. The images were dark-subtracted, flat-fielded, and analyzed using the Java^{TM}-based aperture and PSF photometry package developed by one of the authors (TK). The magnitude of the variable was measured relative to GSC 216.709 (Tycho $V = 10.11$, $B - V = +1.06$), whose constancy was confirmed by comparison with GSC 216.417 (Tycho $V = 11.43$, $B - V = +0.37$).

Brno observations were performed on a 40-cm Newtonian telescope using an ST-7 camera and an I-band Kron-Cousins filter. During the outburst, when star was fading we changed exposure times, which are given in Table 1. Images were dark-subtracted, flat-fielded and analyzed using Munidos photometry package (Novák 1998). The magnitude of variable was determined relative to GSC 216.18 which shows no variability up to 0.1 mag limit. Due to cloudy weather some of the CCD frames were omitted from final datasets and in some cases the instrumental magnitude error was quite large. These observations were also omitted.

Tsukuba observations were done using an AP-7 CCD attached to a 25-cm Schmidt-Cassegrain telescope. A Johnson V filter was adopted. The comparison star GSC 216.417 was used to calibrate the magnitude. The constancy of the comparison was confirmed by using a check star GSC 216.18.

All the observations were first shifted by constant magnitudes to best match the Tsukuba V-system. The differences in passbands will not seriously affect the period

Table 1: Summary of observations

start JD[a]	end JD[a]	observatory	band[b]	N^c	t^d
51224.924	51224.990	Kyoto	C	170	30
51225.899	51226.169	Kyoto	C	320	30
51225.948	51226.209	Tsukuba	V	151	120
51226.483	51226.564	Brno	I_C	85	50
51226.901	51227.108	Kyoto	C	471	30
51227.124	51227.217	Tsukuba	V	46	180
51228.317	51228.350	Brno	I_C	23	60
51228.919	51229.232	Kyoto	C	362	30
51229.906	51230.222	Kyoto	C	237	30
51230.386	51230.574	Brno	I_C	100	60
51230.912	51230.975	Kyoto	C	119	30
51230.938	51231.152	Tsukuba	V	88	180
51233.278	51233.475	Brno	I_C	43	70
51234.432	51234.491	Brno	I_C	8	120
51235.122	51235.175	Kyoto	C	10	30
51237.194	51237.197	Kyoto	C	8	30
51239.153	51239.169	Kyoto	C	38	30
51241.158	51241.168	Kyoto	C	27	30
51242.132	51241.171	Kyoto	C	66	30

[a] JD − 2400000
[b] C for unfiltered CCD
[c] Number of frames
[d] Exposure time (s)

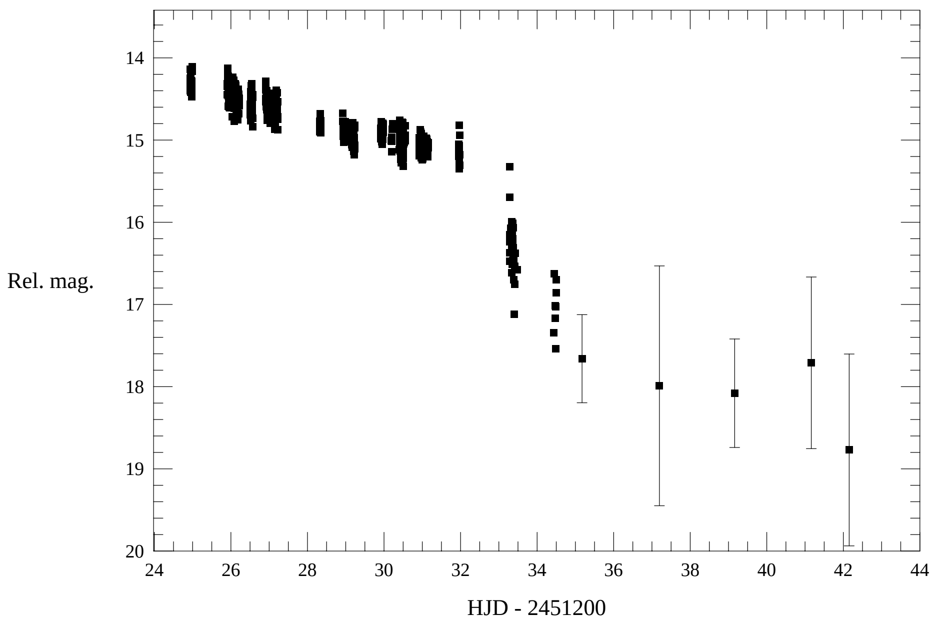

Figure 1. Overall light curve of CT Hya

analysis of outbursting dwarf novae, whose colors are known to be close to $B - V = 0$. Figure 1 illustrates the resultant overall light curve of the present observations. Five consecutive Kyoto observations were averaged to get one point, corresponding to an effective exposure time of 150 s. Before February 22 (JD 2451232) individual observations are plotted; after the decline, nightly averages with error bars are plotted instead. The superoutburst plateau stage (February 15–20) was analyzed, after subtracting the linear decline trend, using the Phase Dispersion Minimization (PDM) method (Stellingwerf 1978).

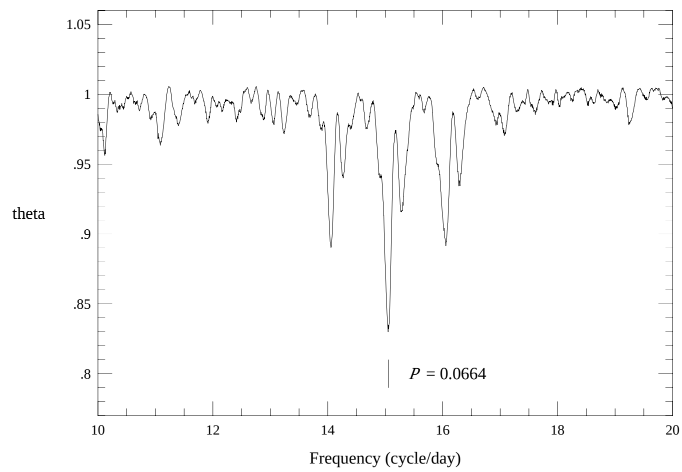

Figure 2. Period analysis of CT Hya

The result of period analysis is given in Figure 2. The period analysis was applied to Kyoto and Tsukuba data, since some ambiguity remained in Brno observations caused by clouds or potential unsolved problem (as described later). The best-determined superhump period is 0.06643 ± 0.00006 d, which corresponds to the longer one-day alias given by Nogami et al. (1996).

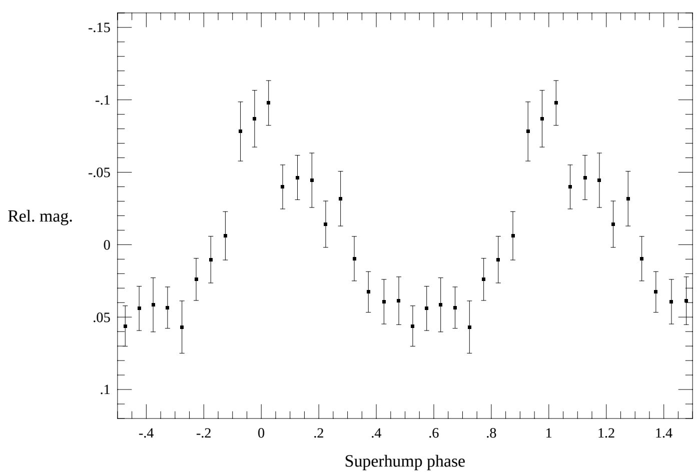

Figure 3. Superhump profile of CT Hya

Figure 3 shows the averaged superhump profile.

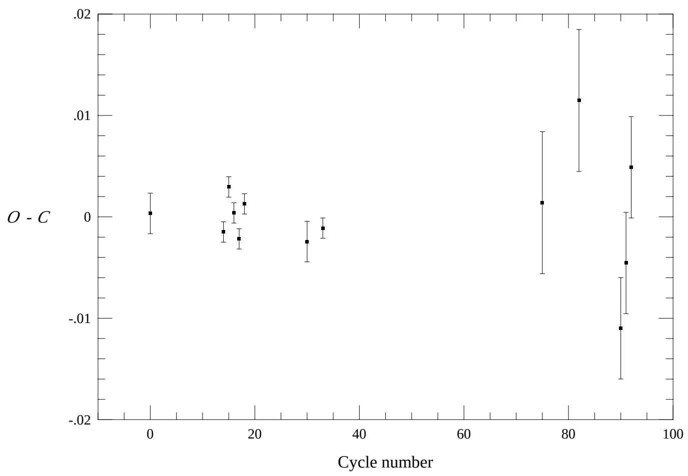

Figure 4. Superhump $O-C$ diagram

Superhump maxima times were measured by eye, and the least-squares fitting yielded the quadratic polynomial equation.

$$\mathrm{Max(HJD)} = 2451224.989(4) + 0.066637(28)E - 0.8(2.7) \times 10^{-6}E^2, \qquad (1)$$

where E is the cycle number (see also Figure 4). The change in the superhump period was negligible, in contrast to usual SU UMa stars which show a rather common superhump period decrease at a rate of $\dot{P}/P \sim -5 \times 10^{-5}$. This lack of period decrease is another common property of short-period SU UMa stars (Kato et al. 1998). We must note the Brno observations on HJD 2451226 were disregarded in this $O-C$ analysis, because this observation showed a nearly reversed superhump phase. The reason is left unsolved, either there was a large change in period or phase, or there may have been an unknown problem in time recording. The problem should be solved in the next superoutburst.

This work is partly supported by the Grant-in-Aid for Scientific Research (10740095) of the Japanese Ministry of Education, Science, Culture, and Sports (TK). Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (KM).

References:

Hoffmeister, C., 1936, *Astron. Nachr.*, **259**, 37

Kato, T., Nogami, D., Baba, H., Matsumoto, K., 1998, in *Wild Stars in the Old West* eds. S. Howell et al., ASP Conf. Series 137, p. 9

Nogami, D., Kato, T., Hirata, R., 1996, *PASJ*, **48**, 607

Novák, R., 1998, http://altamira.asu.cas.cz/~munidos

Stellingwerf, R. F., 1978, *ApJ*, **224**, 953