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

Number 5081

Konkoly Observatory
Budapest
16 May 2001

HU ISSN 0374 – 0676

PHOTOMETRY OF CI Cam DURING QUIESCENCE IN 1999

KATO, TAICHI; UEMURA, MAKOTO

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

CI Cam is the optical counterpart of the intense, rapidly fading X-ray nova XTE J0421+560 in 1998 (Smith et al. 1998; Paciesas and Fishman 1998; Wagner and Starrfield 1998). An ejection of relativistic jets was observed (Hjellming and Mioduszewski 1998a, 1998b), which has made CI Cam = XTE J0421+560 one of the most renowned Galactic microquasars. Before the giant outburst in 1998, CI Cam had been known as a variable star, classified as a possible symbiotic star. The variability of this star was discovered by Miroshnichenko (1994). Miroshnichenko (1994) reported that spectroscopy of the CI Cam = MWC 84 revealed absorption features typical for late-type stars. Miroshnichenko (1994) also reported a photometric period of $11\overset{\mathrm{d}}{.}7$ with an amplitude of $0\overset{\mathrm{m}}{.}3$. In order to confirm this suggested periodicity, we performed CCD photometry.

The CCD observations 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$^{\mathrm{TM}}$-based aperture photometry package developed by one of the authors (TK). The magnitudes were determined relative to GSC 3723.54, whose Tycho-2 magnitude is $V = 10.50 \pm 0.04$ and $B - V = +0.79 \pm 0.07$. The constancy of comparison star during the run was confirmed by comparison with GSC 3723.65 and GSC 3723.80.

A total of 259 useful frames between 1999 October 22 and 1999 December 28 were obtained. The light curve drawn from the resultant data is presented in Figure 1. The light curve shows relatively irregular variation, with a total amplitude of $0\overset{\mathrm{m}}{.}2$. Small, nightly variations are superimposed on a general, slowly declining trend. A period analysis has yielded no coherent periodicity between 1 and 30 d. There was no indication of the 11.7-d periodicity. Post-outburst photometry between 1998 August and 1999 February (Clark et al. 2000) reported small variations, but the small number of data points made it impossible to analyze the possible periodicity or the time scale of variations. Clark et al. (2000) suggested a possible effect of the 1999 event in their post-outburst data. Our photometry at later epochs than theirs is expected to more closely reflect the quiescent activity.

The most remarkable short-term variation in our data was observed on JD 2451485 (1999 November 2), when a $0\overset{\mathrm{m}}{.}10$ jump was observed within one day. The brightening lasted less than one day, and the object faded by $0\overset{\mathrm{m}}{.}09$ on the subsequent night. The time scale of the variation was comparable to the e-folding time of $\sim 0\overset{\mathrm{d}}{.}5$ d of the 1999 event. Since CI Cam was observed to be X-ray active even during quiescence (cf.

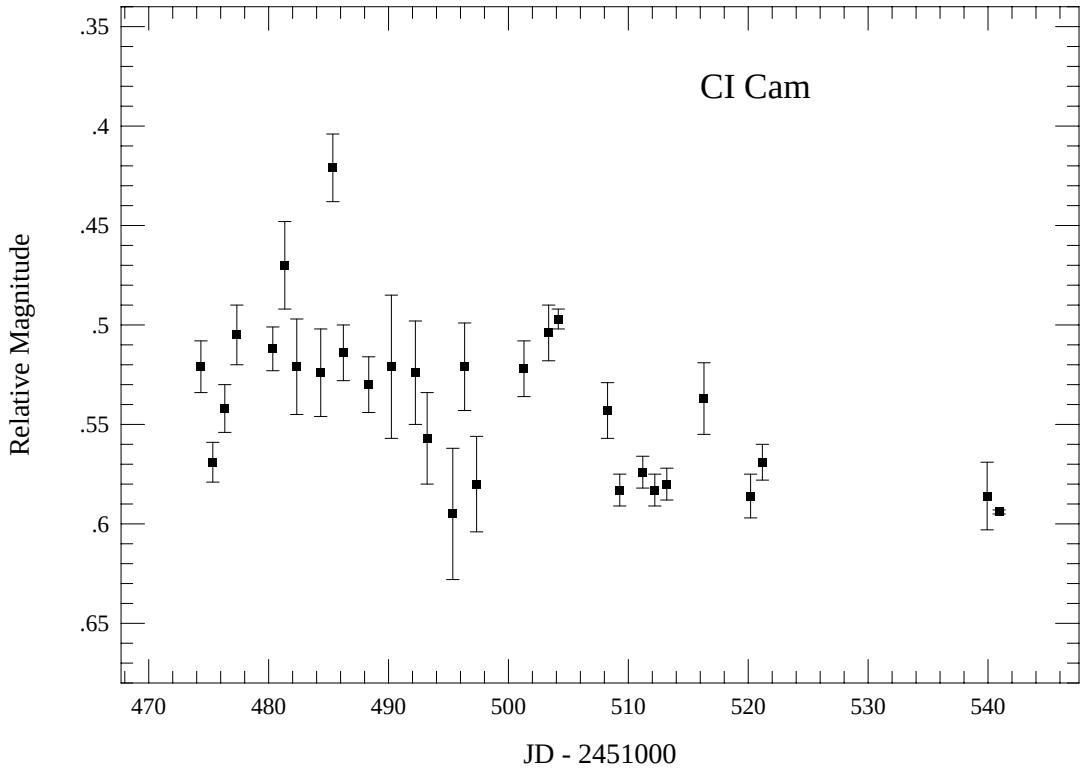

Figure 1. Light curve of CI Cam. Each point represents nightly averaged magnitudes

Parmar et al. 2000), it is not surprising if a "miniature" outburst may have been responsible for the transient optical brightening. The BATSE earth-occultation light curve (http://cossc.gsfc.nasa.gov/batse) does not show a marked increase of the X-ray flux on the corresponding day, but has a slightly increased detections 5 to 10 days after the optical brightening. The optical brightening thus may have been a precursor to the weak X-ray activity.

Part of this work is supported by a Research Fellowship of the Japan Society for the Promotion of Science for Young Scientists (MU).

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