OBSERVATIONS OF THE DEEPLY ECLIPSING DWARF NOVA GY Cnc

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Abstract. We present photometric measurements of the eclipsing dwarf nova and X-ray source GY Cnc. The observations were collected during outbursts and in quiescence. The investigation of plates from the Sonneberg archive showed that the mean outburst interval is about 210–270 days, that the outburst is very fast, and lasts for about 5 days.

Keywords: binary stars, cataclysmic variables, X-ray source

1. Introduction

Cataclysmic variables (CVs) are binary stars of very short orbital period, in which a low-mass red K–M dwarf star (the secondary) transfers mass to a white dwarf (the primary). CVs are subdivided into some sub-classes including dwarf novae and nova-likes variables. RX J0909.8 + 1849 = GY Cnc ($\alpha_{2000} = 09^{\rm h}09^{\rm m}50.56^{\rm s}$, $\delta_{2000} = 18^{\circ}49'47.2''$) was identified as an X-ray source by *ROSAT* and as a possible CV by Bade et al. (1998). The first outburst of GY Cnc with an amplitude of up to 12 mag was independently detected by Gänsicke et al. (2000) and the VSNET-team (Kato et al., 2000) in February 2000. The photometric observations during the outburst were provided by the VSNET team (Kato et al., 2000) and Gänsicke et al. (2000) immediately, and they classified GY Cnc as a dwarf nova. Both groups observed the object during several February nights. They found the eclipse with a depth of 2–3 mag and pointed out that there are no humps in the light curve during the outburst. In April 2000 Thorstensen (2000) and Shafter et al. (2000) studied this star spectroscopically during quiescence. The next outbursts occurred in October 2000 and November 2001. The November 2001 outburst was described by Kato et al. (2002), who gave the ephemeris

$$BJD\,(\text{mid} - \text{ecl}) = 2451586.21271(8) + 0.17544251(5) \cdot E.$$

The observations during the fourth outburst were carried out by Goranskij and Barsukova (private communication), on December 5 and 9, 2002. Only two sets of observations have been obtained. The latest outburst happened in April 2004.

GY Cnc is one of a few eclipsing dwarf novae with a period above the "period gap": EX Dra, IP Peg, BD Pav, and the possibly new dwarf nova V367 Peg (see

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Katysheva and Pavlenko, 2003). Also only a few dwarf novae show X-ray emission, e.g. EX Dra. So GY Cnc can be an intermediate polar (Kato et al., 2002).

2. Photographic Archive Data

Shugarov et al. (2003) analyzed 730 plates of the Sonneberg plate collection from 1930 to 1990 to verify any outburst activity of GY Cnc. The star was seen only during its outbursts (above 13–14 mag) and was not visible in quiescence ($\sim$17 mag). At least 24 outbursts of this star have been observed (18 are certain and 6 uncertain). In maximum it reached $12.^m5$. The magnitudes of the comparison stars in the blue photographic system *pg* (close to *B*) are given in Shugarov et al. (2003). It is very difficult to estimate the outburst cycle, because observations are scarce. But the minimum outburst interval we found is about 43–60 days. In Table I, we present Julian Dates of the bright states and the intervals between outbursts (Δt). Of course, the epochs of archive observations were sporadic. But the mean outburst interval may be about 210–270 days. A coadded outburst light curve was obtained by a displacement of the individual light curves in time. It is very fast and lasts for about 5 days (Shugarov et al., 2003). The outburst curve shows a very sharp rise (about 1 day), a plateau (2 days) and a decline (2 days). Gänsicke et al. (2000) and Kato et al. (2000) also noted that outbursts of GY Cnc are shorter than the typical ones of IP Peg, for example.

3. CCD Observations

We began our CCD observations of GY Cnc after having received the VSNET notification in February 2000 and kept on our monitoring since then. One run (in *R*) was obtained during the second outburst on 21 October 2000. Last photometry

TABLE I

Dates of outbursts, JD 2400000+

Date	Δt (days)	Date	Δt (days)	Date	Δt (days)	Date	Δt (days)
27924		39024	522	47238	367	51584	1862
33305	5381	39579	555	47852:	614	51839	255
34120	815	42149	2570	48361	509	52238	399
35209	1089	45017	2868	48691:	330:	52618	380
35870	661	45760	743	48986:	295:	53098	480
36246	376	46079	319	49029*	43*		
36631:	385	46437	358	49090*	61*		
38502:	1871	46871	434	49722	632		

Note. ":" denotes uncertain value, "*" denotes the minimum interval between two outbursts.

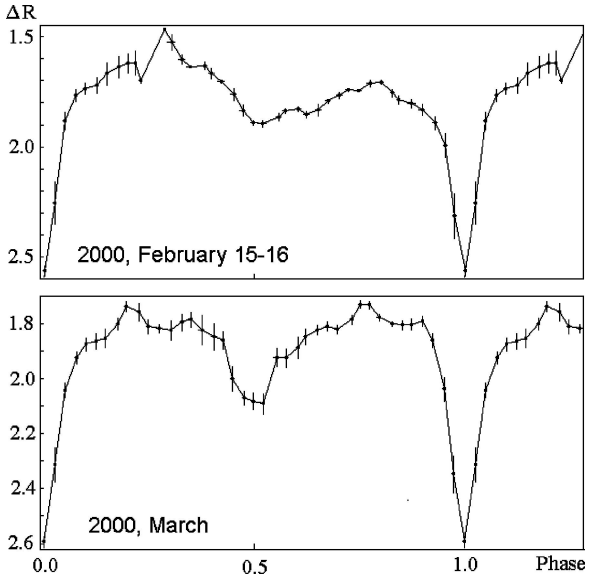

Figure 1. Mean light curves of GY Cnc in R band (relative units).

was obtained in January 2004. In general, our runs were made at the Crimean Laboratory of Sternberg Astronomical Institute. We used the 38, 60 and 125 cm telescopes equipped with the SBIG ST–7, ST–8 and AP–7 CCD cameras.

Figure 1 presents the mean R light curves at the end of the outburst in February 2000 and during quiescence (March 2000) folded with the period $0.^d175446$. In contradiction to the very smooth outburst light curves (Gänsicke et al., 2000; Kato et al., 2002; Shugarov et al., 2003) we can see the eclipse of the secondary in R ($\Delta R \sim 0.4$). It is noteworthy that there is also a secondary eclipse in I of about 0.25 mag and a possible hump before the main eclipse.

Unfortunately, we got only one light curve in the R band during the outburst on 21 October, 2000, and we do not know what outburst day it is, but probably close to an outburst maximum. The eclipse light curve of this day (Figure 2) is very smooth, without any humps. The absence of humps during the outburst can be explained by an enlarged disk giving rise to the main part of radiation. The minimum is asymmetric, with the egress part being steeper than the ingress (16.5 min versus 6.6 min). The observations show how the disk is becoming more homogeneous during the rise to this outburst.

For the mass and radius of the secondary we got $M_2/M_\odot = 0.48$ and $R_2/R_\odot = 0.46$, using the relations by Warner (Warner, 1995): $M_2/M_\odot = 3.18 \cdot 10^{-5} P_{\rm orb}$ (sec) and $R_2/R_\odot = 0.959 M_2/M_\odot$. These values are similar to the ones given by other authors.

The archive and modern data provide evidence for very short outbursts and a large outburst interval. The hot spot is weaker than in most dwarf novae. There

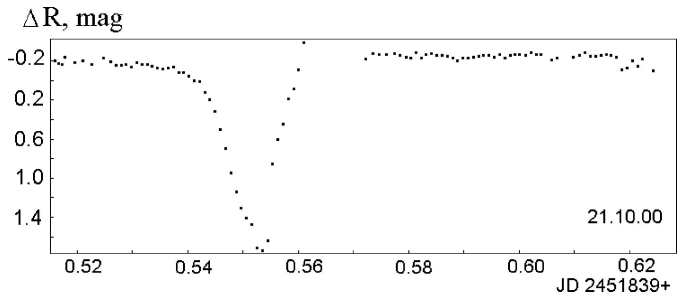

Figure 2. The outburst *R* light curve of GY Cnc (relative units).

were two other outbursts observed besides those described by the above-mentioned authors.

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