COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4759

Konkoly Observatory
Budapest
30 August 1999

HU ISSN 0374 – 0676

THE FEBRUARY 1999 SUPEROUTBURST OF THE SU UMa-TYPE DWARF NOVA CG CMa

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CG CMa is a poorly known cataclysmic variable. It was discovered by C. Verlooy on Franklin-Adams plates taken in January 1934. Maximum light, $m_{\rm pg} = 13.7$, was observed on 1934 January 12; the object had been below the plate limit of $15^{\rm m}\!.5$ four days before. It declined $2^{\rm m}$ in about 25 days, and subsequently fell below the plate limit. Van Hoof (1948) published a discovery note with the light curve and a hand-drawn finding chart. He classified it as "apparently a faint nova". Payne-Gaposchkin (1977) noted the unusual position of this "nova" near the galactic anticentre at a large galactocentric distance (if a typical nova luminosity is assumed), and commented "CG CMa might prove to be a U Gem star or a recurrent nova".

On the basis of the finding chart and an additional Harvard photograph of quite insufficient plate scale, Duerbeck (1987) tentatively identified CG CMa at its minimum stage with a star of $m_{\rm pg} = 15.9$. This star is listed as 0600-04772139 in the USNO-A2.0 catalog (CDS VizieR service), with magnitudes $B = 16.5$, $R = 16.5$. Because of the apparently small outburst amplitude, dwarf nova variability was suspected. A spectroscopic investigation by Zwitter and Munari (1995) yielded an A type spectrum, and the authors suspected white dwarf characteristics.

The discovery of a new outburst on 1999 February 22.494 (UT) by R. Stubbings (1999) lead us to reconsider the case. B, V, R and I frames of the field were obtained (by J.H.K.) at the Cassegrain focus of the 1.0-m Jacobus Kapteyn telescope at La Palma on 1999 March 7.87 (UT). They show the object as a close companion to 0600-04772139. Using a local sequence by Duerbeck (in preparation), CG CMa yields the following magnitude and colours at this late stage of the outburst: $V = 15.95, B-V = 0.10, V-R = 0.00$. Its position and that of the USNO star were determined, using sixteen nearby stars selected from the USNO-A2.0 catalog, with the aid of the MIDAS/ASTROMET package:

CG CMa	RA = $07^{\rm h}04^{\rm m}05^{\rm s}\!.225$	Decl. = $-23^\circ45'34''\!.3$	(equinox J2000.0)
0600-04772139	RA = $07^{\rm h}04^{\rm m}05^{\rm s}\!.04$	Decl. = $-23^\circ45'34''\!.6$	(equinox J2000.0)

CG CMa lies about $2''\!.55$ east of 0600-04772139. The coordinates of both stars are in very good agreement with those measured by Henden (1999).

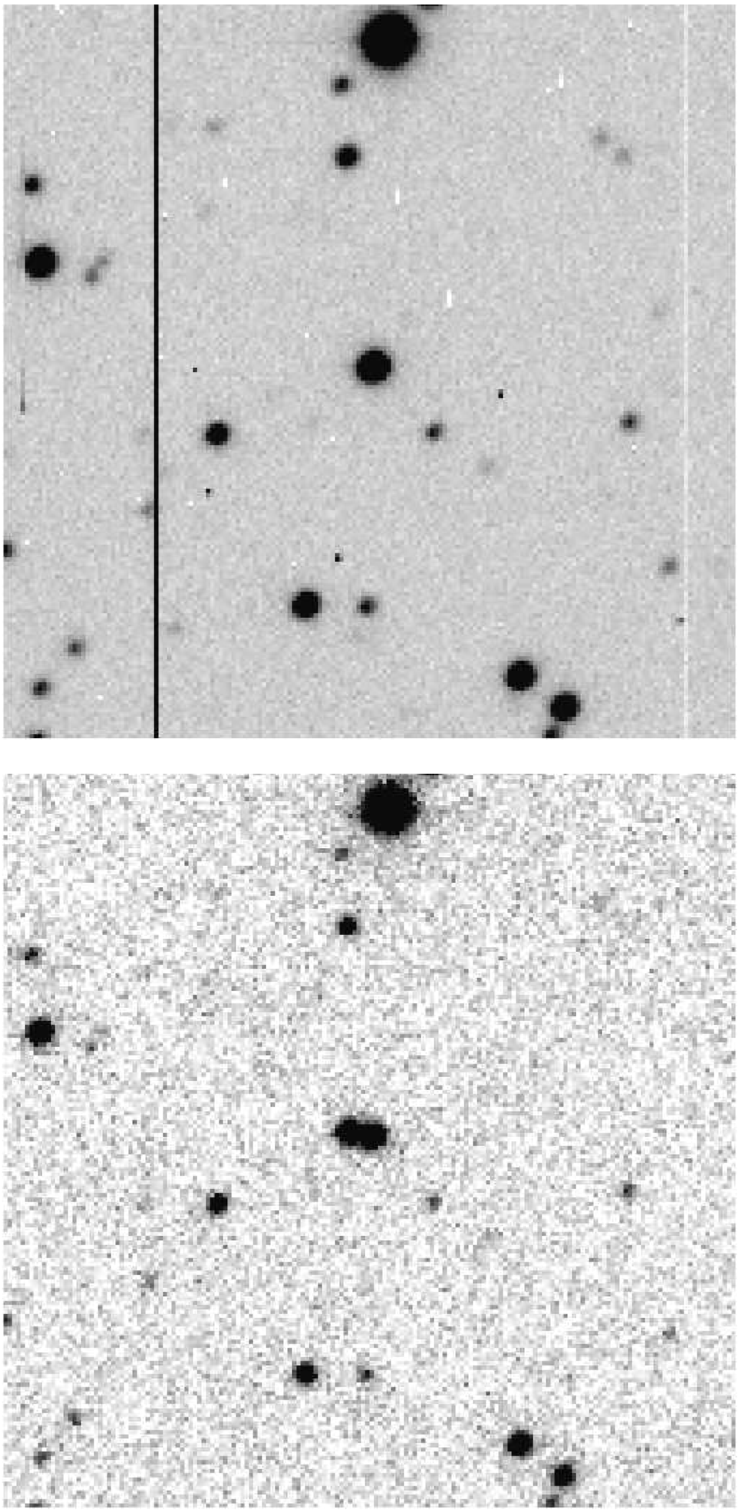

Figure 1. The field of CG CMa in 1989 (R band, at minimum) and in 1999 (I band, at outburst). North is on top and west to the right. The dwarf nova is the eastern component of the close double star in the centre of the image. The field size is about $80'' \times 80''$. At minimum, no counterpart is seen down to $R = 22^{\mathrm{m}}$

CG CMa was below $V = 15.0$ on 1999 February 21.493 (UT), it reached $V = 13.7$ on 1999 February 22.5, and had fallen by $2^{\rm m}$ around 1999 March 5, according to data published in VSNET

(http://www.kusastro.kyoto-u.ac.jp/vsnet/LCs/index/cmacg.html).

Thus the decline ($2^{\rm m}$ in 11 days) is faster than that of 1934. The brightness declines must always be treated with caution, because they are based on the combined light of both stars.

Archival CCD frames of the field, taken 1989 January 10 with the ESO/Danish 1.54-m telescope at La Silla (by H.D.), show no trace of CG CMa at minimum. 0600-04772139 yields $V = 16.39$, $B - V = 0.54$, $V - R = 0.33$. The 1989 and 1999 frames are shown in Fig. 1. Using IRAF/DAOPHOT, the profile of the companion star was subtracted on the 1989 frame, but the residual image also does not show a trace of the cataclysmic variable. We estimate a *bright limit* of about $22^{\rm m}$ in V and R, and about $21^{\rm m}$ in B for CG CMa at minimum.

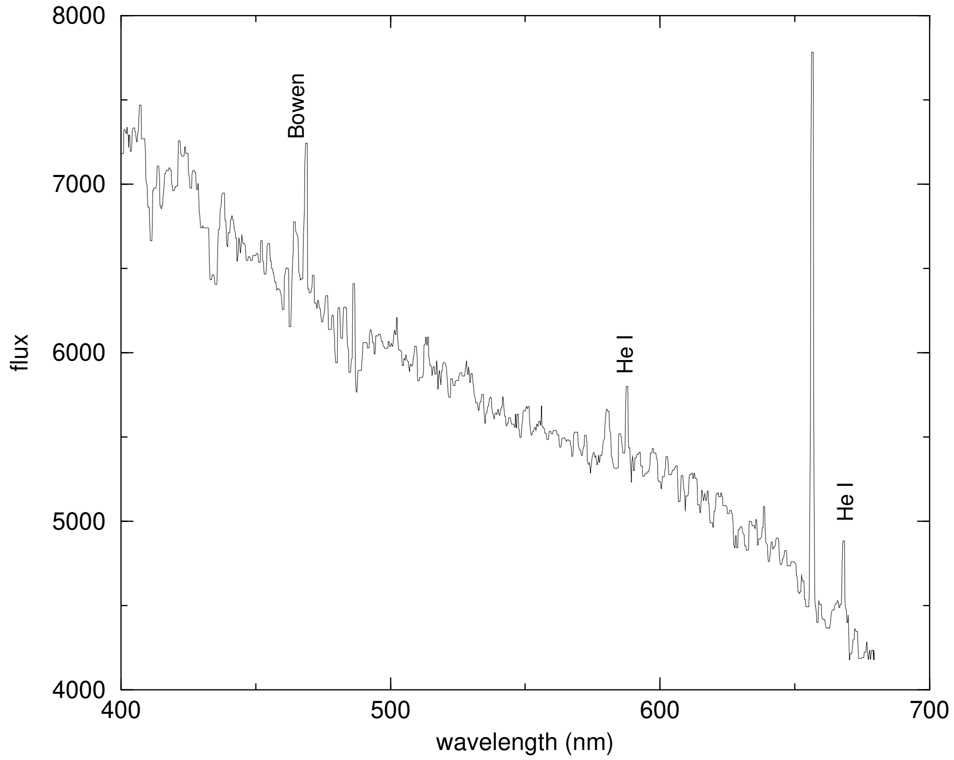

Figure 2. The spectrum of CG CMa on 1999 February 22.94 (UT), in the early stages of the outburst. A few spectral features are marked

A spectrum of CG CMa was obtained (by D.P.) with the 2.5-m Isaac Newton telescope on 1999 February 22.94 (UT), in the early stages of the outburst, with an exposure time of 300 sec (Fig. 2). Superimposed on a strong continuum which rises towards shorter wavelengths, Hα 6563 appears as a strong emission line, surrounded by a broad absorption trough, whose full width corresponds to 1550 km/s. Hβ 4861 also appears as an emission embedded in a broad trough (full width 3800 km/s), but it is so weak that it hardly reaches the continuum level. Higher Balmer lines may show a similar structure. The Bowen complex, He II 4686, C III/N III 4650, appears as a strong emission, and lines of

He I at 587.6 and 667.8 nm are also in emission. The full width at half maximum of the emission lines Hα, Hβ and He II 4686 is about 570 km/s. The spectrum is quite typical of SU UMa-type dwarf novae at superoutburst; see e.g. the descriptions of RZ Leo and HV Vir (Cristiani et al. 1985, della Valle et al. 1992).

The brightness at maximum of GC CMa is about $B = 13.75$, if one takes van Hoof's maximum observation $m_{\rm pg} = 13.7$ at face value, and estimates $B = 13.8$ from Stubbings' visual observations, by applying the $B - V$ colour index observed later in the outburst. Thus the amplitude is larger than $7^{\rm m}$. Brightness modulations with a superhump period of 0.0636 days were observed in the last days of 1999 February (Kato et al. 1999). These facts, together with the spectral appearance and the apparently long recurrence time, make CG CMa a certain member of the SU UMa group of dwarf novae, possibly of WZ Sge subtype. Such objects have absolute visual magnitudes at minimum between $8^{\rm m}$ and $11^{\rm m}$, and in extreme cases may be as faint as $13^{\rm m}$ (Warner 1995). The galactic extinction, as estimated using the routine EXTINCT by Hakkila et al. (1997), is very low ($A_V = 0.08$ at 1 kpc). Assuming a value $13^{\rm m}$ for the absolute magnitude, a lower limit of about 600 pc can be set to the distance of CG CMa.

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