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

Number 4915

Konkoly Observatory
Budapest
26 June 2000

HU ISSN 0374 – 0676

V803 CEN – THE SECOND "HELIUM ER UMa STAR"

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Small group of helium-rich variable stars, known as AM CVn stars, are considered as ultra-short period interacting binary white dwarfs (for a review, see Warner 1995). Among AM CVn stars, CR Boo, V803 Cen and CP Eri are known to show large-amplitude variations up to five magnitudes, on a time scale of less than a day to several months. The origin of such large-amplitude variation is still poorly understood. Warner (1995) proposed the similarity to VY Scl-type cataclysmic variables, whose "low states" are generally believed to result from reduced mass-transfer. Tsugawa and Osaki (1997) applied the dwarf nova-type thermal and tidal instability model to the helium disk systems, including CR Boo and V803 Cen. They succeeded in understanding the behavior of these systems by considering the stability of the accretion disk depending on the mass-transfer rate. Tsugawa and Osaki (1997) expected that intermediate mass-transfer systems, such as CR Boo and V803 Cen, will undergo dwarf nova-type disk instability, analogous to SU UMa-type dwarf novae in hydrogen-rich systems. They suggested higher mass-transfer systems would resemble ER UMa stars, which are a subgroup of SU UMa-type dwarf novae having extremely short supercycle length (for a review, see Kato et al. 1999). Subsequent observation indeed confirmed the presence of 46.3-d supercycle in CR Boo (Kato et al. 2000), whose behavior is extremely analogous to ER UMa stars. The application to the next candidate, V803 Cen, has been naturally sought as a part of VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/).

Visual observations were performed using 32-cm (R.S.), 32-cm (B.M.) and 40-cm (A.P.) reflectors. All observations were done using photoelectrically calibrated V-magnitude comparison stars. The typical error of visual estimates was less than 0.2 mag, which does not affect the following discussion. The total number of observations between 1998 November 17 and 2000 June 12 was 464.

The overall light variation is presented in Figure 1. Each filled square represents single estimates and '$\vee$' sign represents upper limits. The quasi-periodic occurrence of bright states and faint states associated with brief brightenings is clearly demonstrated. The behavior is very reminiscent of that of CR Boo (Kato et al. 2000). The light maxima are separated by $\sim$ 77 d in each observing seasons of 1998–1999 and 1999–2000. We consider this period as the representative supercycle. Individual observations are folded by this period, using the maximum epoch of JD 2451271 for the 1998–1999 season and

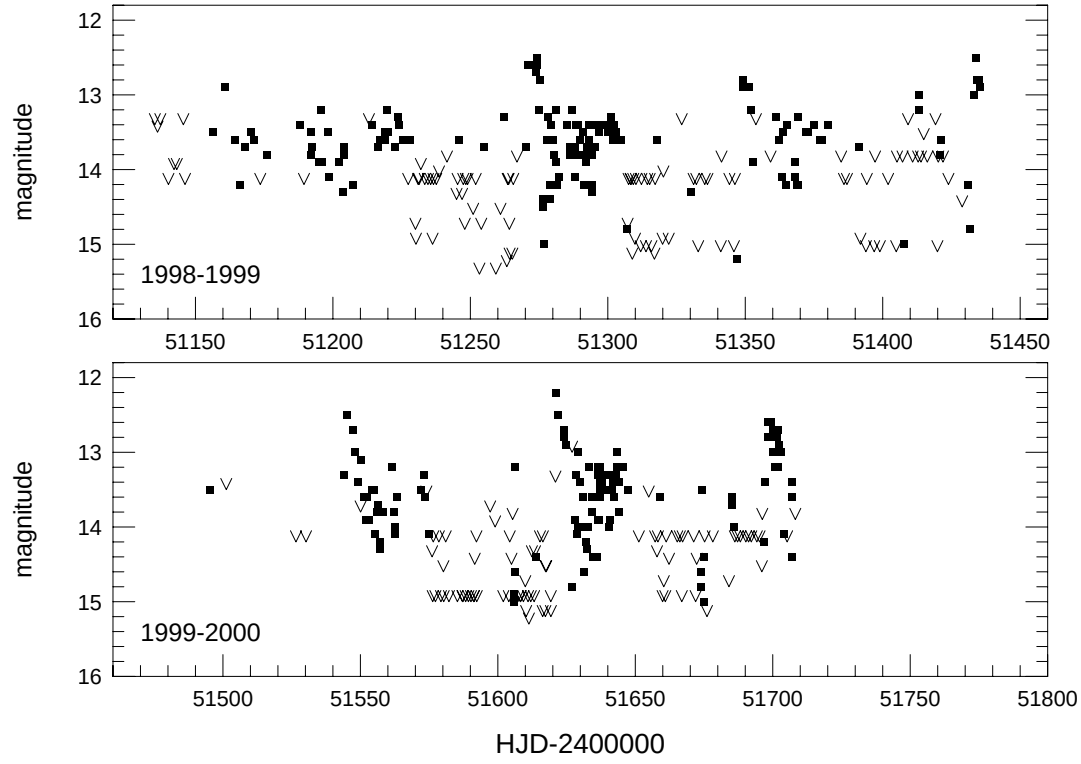

Figure 1. Overall light curve of V803 Cen

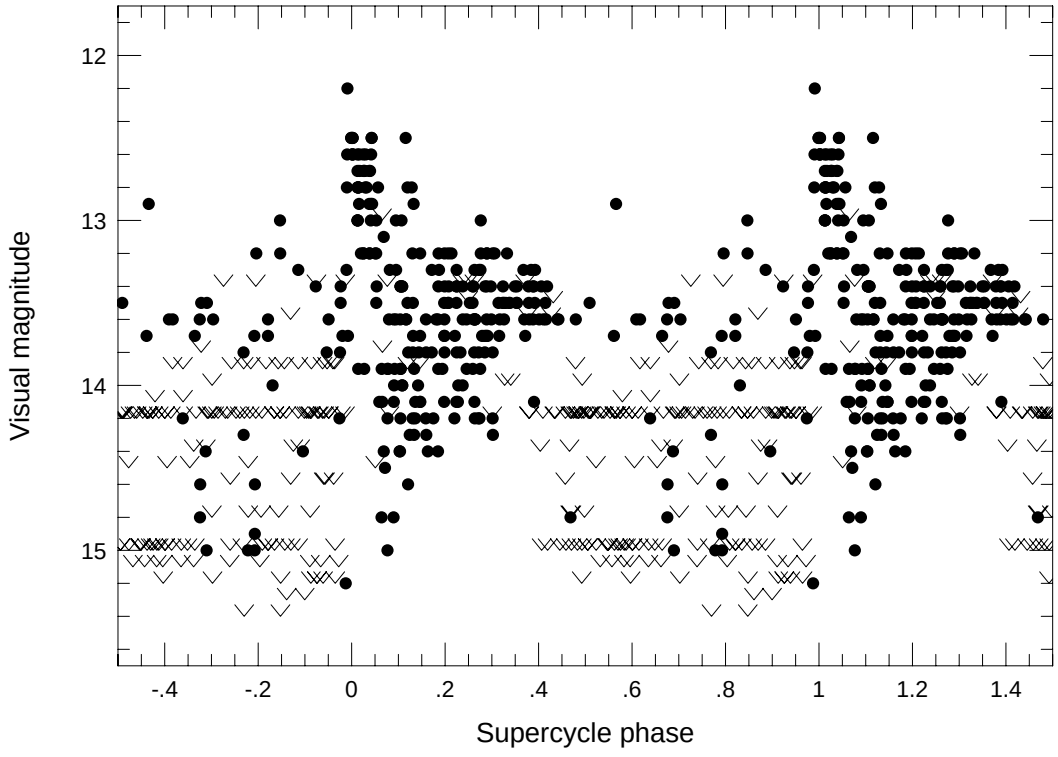

Figure 2. The 77-d supercycle of V803 Cen

Table 1: Comparison of V803 Cen and CR Boo

	V803 Cen	CR Boo
V-magnitude range	12.2–16.8	13.0–17.5
main photometric period (s)	1611	1490
supercycle length (d)	77	46.3
superoutburst duty cycle	0.4	0.5

JD 2451545 for the 1999–2000 season. The interval was 111 d between the last maximum of the 1998–1999 season and the first maximum of the 1999–2000 season. This may suggest some change occurred around the solar conjunction. However, by treating the two seasons separatedly, the quasi-periodic outburst pattern was found to be highly stable within each seasons.

Figure 2 represents the folded light curve of V803 Cen, which shows a pattern very similar to that of CR Boo, "the helium ER UMa star" (Kato et al. 2000). The bright phase (superoutburst) comprises a duty cycle of ~ 0.4 supercycle, which is close to the value ~ 0.5 in CR Boo. Large-amplitude damping oscillations were observed during the decay from the superoutburst maximum, which may correspond to short-term modulations with a time scale of a day (Patterson et al. 2000), and the feature suspected as "dips" in CR Boo (Kato et al. 2000). During the rest of supercycle phase (phase 0.6–1.0), the object is mostly faint with short brightenings, which are likely to correspond to normal outbursts in SU UMa-type dwarf novae. The overall behavior of V803 Cen can be understood as a natural extension of the CR Boo activity toward the lower mass-transfer rate, which is perfectly what is expected from its supposed orbital period (Tsugawa and Osaki 1997). The parameters of these two "twin" systems are summarized in Table 1: outburst parameters from this work and Kato et al. (2000) and main photometric period from Warner (1995).

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