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

Number 5109

Konkoly Observatory Budapest 9 June 2001

 $HU\ ISSN\ 0374-0676$

ON THE SUPERCYCLE LENGTH OF HS Vir

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HS Vir is a dwarf nova originally discovered as an ultraviolet excess object PG 1341-079, whose cataclysmic nature was subsequently identified by spectroscopy (Green et al. 1982, 1986). The first extensive photographic observations were done by Osminkin (1985), which revealed the existence of relatively frequent, short, faint outbursts, and the presence of a bright (~ 12^m8) outburst. This outburst pattern, together with the likely orbital period of 0^d.0836 (or its alias) from radial-velocity study by Ringwald (1993), makes HS Vir a good candidate for an SU UMa-type dwarf nova. However, it took a relatively long time before the nature of the object was revealed. Kato et al. (1995) reported frequent short outbursts with a recurrence period of 8 d, but no apparent superoutburst was recorded. Kato et al. (1998) finally identified a superoutburst occurring in 1996 May. In spite of the long-term coverage, no additional superoutburst was observed. Kato et al. (1998) only concluded that the supercycle of HS Vir should be longer than 80 d. As discussed in Nogami et al. (1997), Kato et al. (2000) and also Kato et al. (1998), HS Vir has been proposed as an intermediate object between usual SU UMa-type dwarf novae and peculiar ER UMa stars (for a review, see Kato et al. 1999). Determination of supercycle of HS Vir thus has been a long-wanted job.

Since the identification as an SU UMa-type dwarf nova, this star has been monitored as a part of the VSNET Collaboration (http://www.kusastro.kyoto-u.ac.jp/vsnet/). The visual observations were done 32-cm (R.S.), 40-cm (A.P.), 20-cm (P.A.D.), 30-cm (H.I.) and 25-cm (M.S.) reflectors. The CCD observations were done using an Apogee AP-7 attached to a 25-cm telescope (S.K.). A V-band filter was used for the CCD observations. All observations used comparison stars calibrated in the V-band. Nightly averaged magnitudes for CCD observations were used for the following analysis. Three additional superoutbursts were recorded up to 2001 June. Table 1 lists the known of superoutbursts of HS Vir.

| ID . | | |
|------------|----------------|----------------------|
| JD maximum | peak magnitude | source |
| 2450154 | 13.6 | Kato et al. (1998) |
| 2451316 | 13.4 | this work |
| 2451689 | 13.3 | this work |
| 2452058 | 13.3 | this work |

Table 1: Superoutbursts of HS Vir

As is already evident from Table 1, there is a clear cycle of 371 d, determined from the recent three superoutbursts. The superoutburst detected by Kato et al. (1998) also approximately fits to this period. By assuming three supercycles between the first and second superoutbursts, the mean cycle length becomes 382 d. However, this value should be treated with caution since Kato et al. (1998) reported a change in the outburst characteristics in 1997. The best determined supercycle of HS Vir is thus 371 d or its *n*-th size. While available observations can reject periods shorter than 124 d (one-third of 371 d), the half period of 186 d cannot be excluded because of observational gaps around solar conjunctions. Since the period of 371 d is close to one year, the clear discrimination of these possibilities might be hard to achieve in the near future. We therefore consider on two possibilities: 186-d supercycle and 371-d supercycle. Figure 1 and 2 represent folded light curves by the two candidate periods of 186 d and 371 d, respectively. Only positive observations are plotted in order to avoid confusion.



Figure 1. Light curve of HS Vir folded by a period of 186 d

Both figures are acceptable for a supercycle light curve of an SU UMa-type dwarf nova. Because normal outbursts are faint and short, many of them must have escaped from the



Figure 2. Light curve of HS Vir folded by a period of 371 d

present detection. Given the cycle length of 8 d (Kato et al. 1995) for normal outbursts, the number ratios of (normal outbursts)/(superoutbursts) become ~ 23 and ~ 46 for the periods of 186 d and 371 d, respectively. These values are rather large compared to most of SU UMa-type dwarf novae (e.g. Nogami et al. 1997). However, the latter large value is not perfectly exceptional, as WX Hyi is another example showing a large number ratio of (normal outbursts)/(superoutbursts). Given the long orbital period of 0.07692 (Mennickent et al. 1999), HS Vir may be a system marginally unstable to the tidal instability, lying close to the border of SU UMa-type and SS Cyg-type dwarf novae.

References:

Green, R. F., Ferguson, D. H., Liebert, J., Schmidt, M., 1982, PASP, 94, 560

Green, R. F., Schmidt, M., Liebert, J., 1986, ApJS, 61, 305

- Kato, T., Hanson, G., Poyner, G., Muyllaert, E., Reszelski, M., Dubovsky, P. A., 2000, *IBVS*, No. 4932
- Kato, T., Nogami, D., Masuda, S., Hirata, R., 1995, IBVS, No. 4193
- Kato, T., Nogami, D., Masuda, S., Baba, H., 1998, PASP, 110, 1400
- Kato, T., Nogami, D., Baba, H., Masuda, S., Matsumoto, K., Kunjaya, C., 1999, Disk Instabilities in Close Binary Systems, p. 45, eds. S. Mineshige, J. C. Wheeler (Universal Academy Press, Tokyo)
- Mennickent, R. E., Matsumoto, K., Arenas, J., 1999, A&A, 348, 466
- Nogami, D., Masuda, S., Kato, T., 1997, PASP, 109, 1114
- Osminkin, E. Yu., 1985, Perem. Zvezdy, 22, 261
- Ringwald, F. A., 1993, Ph. D. thesis, Dartmouth College