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The Near-Synchronous Polar Candidate V4633 Sgr (Nova Sagittarii 1998)

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Abstract. The classical nova V4633 Sgr (1998) exhibits two photometric periodicities. The shorter period (P_1=3.01 hr) is stable, while the other one, longer by ~2.5%, has decreased monotonically since shortly after the nova eruption, with $\dot{P}_2 \approx -10^{-6}$ (Lipkin et al. 2001).

Here we report on results of photometric monitoring of the star in 2001 and 2002. During our observations, the longer period decreased more, and in 2002 it was only 1.8% longer than P_1. The decrease rate ($\dot{P}_2$) in 2001-2002 was an order of magnitude smaller than in 1998-2000.

These new results support the Near-Synchronous Polar classification which was suggested for V4633 Sgr (Lipkin et al. 2001). In this model, the longer period of V4633 Sgr is the spin of the white dwarf, and its variation since 1998 reflects changes in the moment of inertia of the white dwarf, and angular momentum transfer in the system following the nova eruption.

1. Introduction

A 3-year photometric study of V4633 Sgr (Nova Sagittarii 1998) revealed two periodicities, differing by ~2.5% (Lipkin et al. 2001). The shorter one, P_1 = 3.01 hr, was stable during 1998-2000, and was interpreted as the orbital period of the binary system. The longer periodicity, P_2 = 3.08 hr, monotonically decreased,with $\dot{P}_2 \approx -10^{-6}$, was suggested to be either a superhump (SH), or the spin period of the primary of a Near Synchronous Polar (Lipkin et al. 2001). Here we present results of a continued observations on the star, in 2001-2002.

2. Observations and Results

We conducted time-resolved CCD photometry, mainly through I filter, with the 1-m Telescope at Wise Observatory, Israel. We accumulated 1716 data points in I during 20 nights in 2001, and 25 nights in 2001. The Instrument, the reduction technique, and the time-series analysis techniques we used are described in Lipkin et al. (2001). The 1998-2002 light curve, is shown in Fig. 1 (left panel).

Measurements of the shorter period yielded $P_1(2001) = 3.01351 \pm 0.00024$ hr and $P_1(2002) = 3.01236 \pm 0.00034$ hr. These values are consistent with the mean

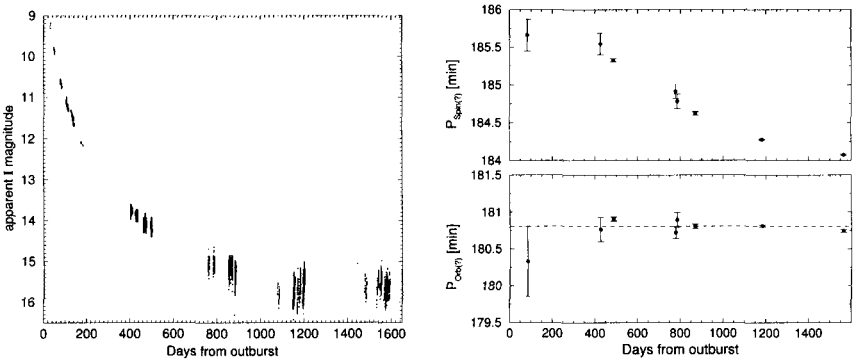

Figure 1. *Left panel:* I-band light curve of V4633 Sgr, 1998-2002. *Right panel:* The values of the two photometric periods of V4633 Sgr, in 1998-2002

period of P_1 in 1998-2000 (3.01382 ± 0.00022 hr). The stability of this period over 5 years promotes its suggested interpretation as the binary period of the system (Lipkin et al. 2001).

The value of P_2 was 3.07130 ± 0.00012 hr in 2001, and 3.06792 ± 0.00019 in 2002, corresponding to $\dot{P} \sim 10^{-7}$ (Fig. 1, right panel). Hence, the decrease of P_1 since the nova eruption has continued. The decrease rate, however, seems to slow down asymptotically.

The 2001-2002 results weaken a SH interpretation of P_2. The small fractional difference between the two periods would require an extremely undermassed, off Main-Sequence secondary. Also, the 5-year monotonic trend is not characteristic of shuperhump systems (Lipkin et al. 2001).

Our results support the Near-Synchronous Polar model, in which the longer period of V4633 Sgr is interpreted as spin of the white dwarf. The observed continued spin-down is a natural result in this model, and reflects changes in the moment of inertia of the white dwarf, and angular momentum transfer in the system following the nova eruption (in analogy to the evolution of the spin period in Nova V1500 Cyg (1975) during the first 1-2 years after it's eruption, Stockman, Schmidt & Lamb, 1988). However, this model should be tested by an observational search for evidence for the magnetic nature of the system, e.g. by X-ray observations and/or time-resolved polarimetry.

The mean brightness of the star in 2001 and 2002 was the same (I=15.6 mag). This, and the general shape of the 1998-2002 light curve (Fig. 1, left panel) suggest that the post nova will remain at this brightness level in the next few years.

References

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