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THE PRECURSOR OF NOVA AQUILAE 1999 = V1493 Aql

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Nova Aql 1999 (V1493 Aql) was discovered in outburst by A. Tago (cf. IAU Circ No. 7223) on July 13.6, 1999. Detailed spectral observations by Tomov et al. (1999) for the days immediately following the maximum brightness set the expansion velocity of the nova at $\sim$ 1700 km sec^{-1}; note the strong NaI D interstellar lines which suggest a large reddening and classify the nova among the *Fe II class* of Williams (1992).

A detailed photometric monitoring of the nova evolution has been provided by VSNET. It shows the nova reached a maximum brightness $V \sim 9$ mag and has had a complex decline over three months to $V \sim 15.5$ mag.

An important parameter for any nova is the identification of the precursor and consequently the measure of the outburst amplitude. An accurate position for the nova ($\alpha_{\rm J2000} = 19^{\rm h}7^{\rm m}36\overset{\rm s}{.}90$, $\delta_{\rm J2000} = +12°31'26\overset{''}{.}6$) has been provided independently by N. James and G. Masi (cf. IAU Circ No. 7228). This corresponds to an empty position both in DSS-1 and DSS-2, with the closest stars at 4″ and 8″ distance, as shown in Figure 1. The corresponding Palomar plates were taken on May 25, 1952 and May 31, 1987 respectively. The 35 year time span is long enough to detect large proper motions of the field stars and to extrapolate their position to the year 1999. The matching of the two plates does not reveal for any nearby star a proper motion large enough to bring it to the position of the nova for the epoch 1999.

The precursor of Nova Aql 1999 must have been fainter than the plate limits for both DSS-1 and DSS-2, which set the amplitude of the outburst in the $\Delta m \geq 12$ mag range. However, the precursor may have become bright enough to show up on Schmidt patrol plates if it underwent the smaller amplitude outbursts that characterize dwarf novae (DN). A tight link between the binary system properties of DN and classical novae is widely accepted in literature and there are classical novae (for example GK Per = Nova Per 1901) that once back to quiescence conditions are showing DN outbursts (cf. Warner 1995). This note describes the results of our search for such DN outbursts of the precursor of Nova Aql over some decades before the 1999 eruption, by inspection of archive plates from the two Schmidt telescopes of the Padova and Asiago Astronomical Observatories.

The two Schmidt telescopes (40/50 and 67/92 cm) have collected more than 35,000 plates since 1955. In their plate archive we have found 40 plates covering the field of Nova Aql 1999. The basic parameters for the plates are summarized in Table 1. The limiting magnitude of the plates has been derived by comparison with a deep $UBVRI$ comparison sequence calibrated at USNOFS by one of us (AH) which will be published elsewhere.

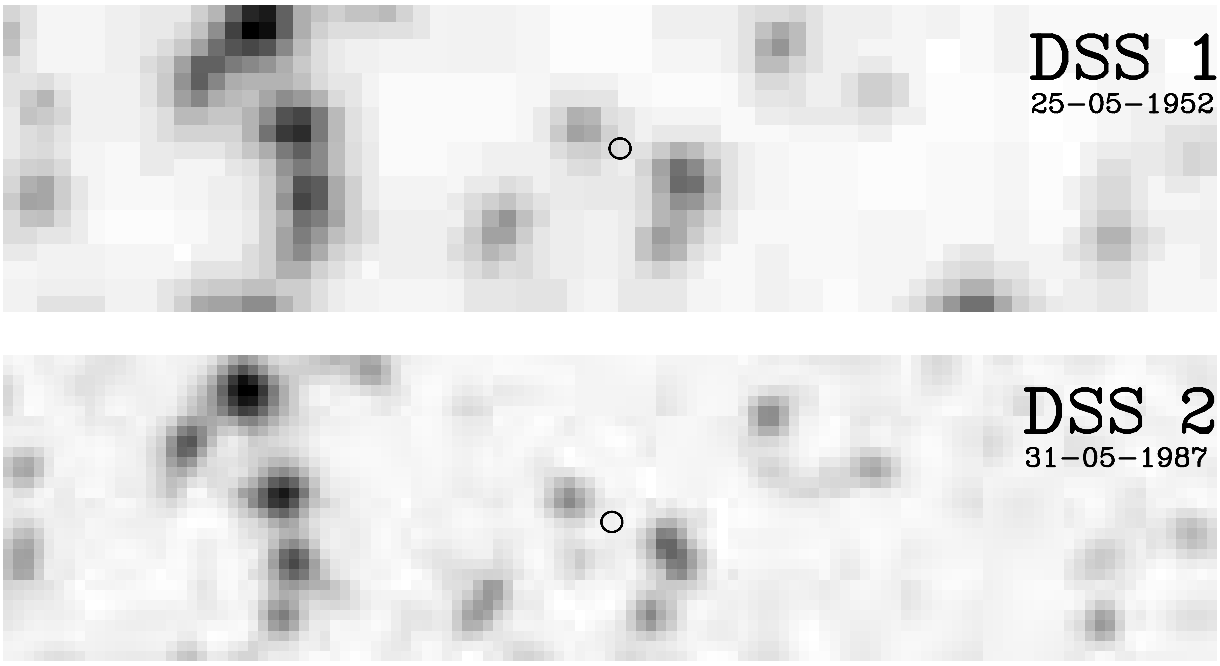

Figure 1. Comparison of the same 120 × 30 arcsec region around the position of Nova Aql 1999 (indicated by the empty circle in the center) from the Palomar DSS-1 and DSS-2.

The progenitor was too faint in quiescence to be recorded by the 1.2-m Palomar Schmidt, and so it has been for the smaller Asiago Schmidt telescopes. Also, no outburst of the progenitor of Nova Aql 1999 has been recorded on the Asiago plates, whose limiting magnitudes cluster around 17.5 mag as shown in Table 1.

There are two basic possibilities to account for the negative detection of DN outbursts for the progenitor of the Nova Aql 1999:

- the progenitor did not experience DN outbursts in the decades preceding its eruption as a classical nova;
- the progenitor indeed went through DN outbursts, but they have not been recorded on the patrol plates because:
  - they were of limited amplitude and the progenitor never became bright enough to be recorded on the plates, or
  - the DN outbursts of the progenitor were of normal amplitude but the progenitor itself is so faint in quiescence that even at outburst maximum it is still too faint to be recorded on the plates, or finally
  - the outbursts are normal but rare and took place when we were not observing.

With the data in hand it is not possible to distinguish among these different possibilities. However it seems fair at least to conclude that the nova progenitor did not have frequent outbursts of large amplitude.

We have already performed a similar investigation for the precursor of Nova Cas 1993 which was bright enough in quiescence to be easily recorded by the Asiago patrol plates (Munari et al. 1993). As in the current study of Nova Aql 1999, the search for DN outbursts in Nova Cas 1993 before its eruption as a classical nova gave negative results.

Table 1: Schmidt plates from the Asiago archive containing the field of Nova Aql 1999. The last column gives the limiting magnitude of the plate (in the band of the $UBVRI$ system closest to the emulsion+filter combination) estimated against a deep $UBVRI$ sequence (see text).

plate #	date	emulsion	filter	exp. t.	lim. mag
2666	14/03/1962	103a-O	–	10^{m}	18.0
2923	02/07/1962	103a-O	–	8^{m}	17.7
2943	07/07/1962	103a-O	–	8^{m}	17.9
2960	09/07/1962	103a-O	–	8^{m}	17.5
4145	16/10/1963	103a-O	–	12^{m}	17.9
4163	19/10/1963	103a-O	–	10^{m}	18.0
4223	07/11/1963	103a-O	–	10^{m}	17.5
4240	17/11/1963	103a-O	–	10^{m}	18.0
4956	05/11/1964	103a-O	GG 13	15^{m}	18.2
5585	23/10/1965	103a-O	GG 13	20^{m}	18.3
5938	16/07/1966	103a-O	–	15^{m}	18.0
6030	22/09/1966	103a-O	GG 13	10^{m}	16.9
6369	30/06/1967	103a-O	–	15^{m}	18.0
6381	04/07/1967	103a-O	GG 13	20^{m}	17.9
6436	24/11/1967	103a-O	–	15^{m}	18.0
6752	22/07/1968	Pan.Royal	GG 13	15^{m}	18.0
6775	24/08/1968	103a-O	GG 13	10^{m}	18.1
6807	24/09/1968	103a-O	GG 13	15^{m}	17.9
6930	22/11/1968	103a-O	GG 13	15^{m}	17.5
7373	17/08/1969	Pan.Royal	GG 14	20^{m}	16.4
7408	11/09/1968	Pan.Royal	GG 14	20^{m}	15.7
7409	11/09/1969	103a-O	GG 13	6^{m}	17.5
7557	29/10/1969	103a-O	GG 13	15^{m}	17.9
7562	01/11/1969	Pan.Royal	GG 14	20^{m}	16.2
7619	28/11/1969	103a-O	GG 13	14^{m}	17.7
8125	05/07/1970	Tri-X	GG 14	20^{m}	16.4
8162	09/09/1970	103a-O	GG 13	15^{m}	17.5
8314	26/10/1970	Tri-X	GG 14	15^{m}	17.9
8315	26/10/1970	103a-O	GG 13	10^{m}	17.9
8741	30/03/1971	103a-O	GG 13	10^{m}	15.8
8969	29/08/1971	Tri-X	GG 14	15^{m}	15.7
9128	20/10/1071	Tri-X	GG 14	20^{m}	16.7
A 1611	13/09/1974	103a-O	GG 13	8^{m}	18.0
9519	05/06/1978	103a-D	OG 2	30^{m}	17.5
9520	05/06/1978	103a-E	RG 1	30^{m}	17.9
13998	19/06/1979	Tri-X	GG 14	15^{m}	16.4
13999	19/06/1979	103a-O	GG 13	5^{m}	17.5
14637	29/06/1981	103a-O	GG 13	8^{m}	17.5
14658	03/08/1981	103a-O	GG 13	10^{m}	17.5
14877	20/07/1982	Tri-X	–	15^{m}	17.5

Our understanding of the physics of the eruptions of classical novae would undoubtedly benefit from a broader knowledge of the photometric behaviour of their progenitor in quiescence. For example the detection, frequency and brightness of DN outbursts may be used to estimate the mass-transfer rate onto the accreting white dwarf prior to the nova eruption (cf. Cannizzo 1993).

The Schmidt telescopes in use around the world generally have sufficiently faint limiting magnitudes to be of interest in the study of nova progenitors, as we have shown for Nova Cas 1993 and Nova Aql 1999, and such investigations on the largest possible set of novae should be encouraged.

References:

Cannizzo, J.K., 1993, *ApJ*, **419**, 318
Munari, U., Tomov, T., Hric, L., Hazucha, P., 1993, *IBVS*, No. 3977
Tomov, T., Moro, D., Munari, U., 1999, *IAU Circ.*, No. 7225
Warner, B., 1995, *Cataclysmic Variable Stars*, Cambridge Univ. Press
Williams, R.E., 1992, *AJ*, **104**, 725