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FOUND A NOVA IN M31: THE TRUE OPTICAL COUNTERPART OF THE M31 SUPERSOFT X-RAY SOURCE 191

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In this note we report the discovery of a nova in M31 (NGC 224) which turned out to be the true optical counterpart of the supersoft X-ray source 191 of the M31 XMM Newton survey catalogue instead of the Nova 1992-01 proposed by Pietsch et al. (2005a). The nova was found by one of us (O.S.) on scanned archival photoplates taken in October and November of 2001 for search for novae in M31 with the Schmidt telescope (80/120/240-cm) at the Baldone Astrophysical Observatory of the Institute of Astronomy, University of Latvia.

The coordinates of the nova were obtained using the Aladin Sky Atlas (CDS) image astrometric calibration tool with respect to the positions of field stars from the $BVRI$ catalogue of M31 (Magnier et al., 1992). The resulting nova position derived from 7 scanned plates is the following:

$$\text{R.A.} = 00^{\text{h}}41^{\text{m}}54\overset{\text{s}}{.}26, \qquad \text{Decl.} = +41^{\circ}07'23\overset{''}{.}9 \qquad \text{(equinox 2000.0)},$$

with 1-sigma error of $0\overset{''}{.}2$. It is located $564\overset{''}{.}4$ West and $524\overset{''}{.}6$ South of the center of M31; a finding chart is given in Figure 1. No record of this object was found in any searches of the papers or WWW pages devoted to novae in M31.

Times of the middle of exposures in Julian days and B-magnitudes of the nova based on the secondary standard stars from the $BVRI$ catalogue of M31 (Magnier et al., 1992) are given in Table 1. The light curve of the nova is presented in Figure 2.

Table 1

JD 2452000 +	B mag	JD 2452000 +	B mag
151.472	> 19.5	204.250	17.7
196.262	16.6	207.390	18.0
198.256	16.8	208.267	18.2
199.282	16.8	226.208	18.5:
203.234	17.3	228.238	> 19.6

The available photometric data for the nova do not allow to determine the time and the value of the maximum brightness exactly. However, the dB/dt parameter can be

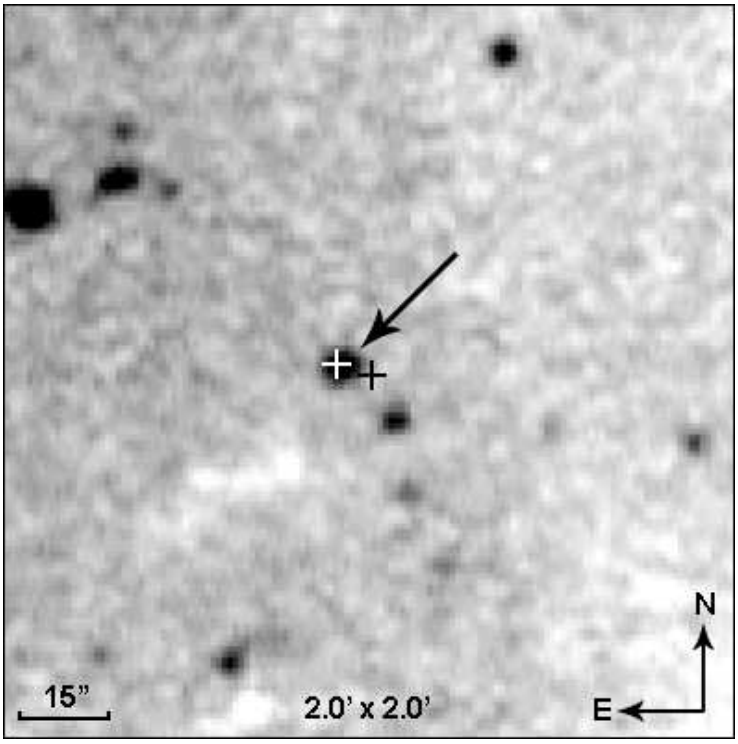

Figure 1. The scan of the photoplate taken on October 15, 2001 with the discovered nova (marked with an arrow). The white and black crosses show positions of X-ray source 191 and Nova 1992-01 respectively

estimated from the general slope of the light curve between the brightest observation, when $B = 16.6$ and the observation closest to 2 magnitudes fainter than the maximum. Excluding an uncertain measurement we estimate $dB/dt = 0.13$ m/d equivalent to the rate of decline $t_2 \sim 15$ days, which corresponds to the fast novae according to the classification by Payne-Gaposchkin (1957). The mean maximum magnitude for novae with similar rate of decline is $B = 16.5$, according to the relation between the rate of decline and the magnitude at maximum for M31 novae obtained by Capaccioli et al. (1989). It could indicate that the first observation of the nova was about one day past its maximum light.

Comparing the nova position with those of X-ray sources in the catalogue of XMM-Newton survey of M31 (Pietsch et al., 2005b) we found that source 191 is located at a distance of $0''.9$ East and $0''.1$ South from the nova. This X-ray source is classified as supersoft as other known X-ray sources identified with novae. The 1-sigma error of X-ray source position is $0''.88$, including systematic error. Within error its position coincides with the position of the nova.

According to Pietsch et al. (2005a) the X-rays at the position of the source 191 was first detected during XMM-Newton observations at JD 2452280.5, so 84 days after the nova outburst and then six days later. No X-ray source was detected at that position during the three XMM-Newton observations made at the moments corresponding to 476, 290 and 107 days before the nova outburst. Evidently this source was not yet active also 17 days after the nova outburst, as it was covered by the Chandra HRC1 observation 1912, but not reported in the catalogue by Kaaret (2002).

Pietsch et al. (2005a), searching for X-ray counterparts of optical novae, correlated this source with the Nova 1992-01, reported by Shafter & Irby (2001) from two Halpha

images, taken in December of 1992 and January of 1993. According to Pietsch et al. (2005a) the time separation of 3303 days between Nova 1992-01 outburst and X-ray source rise is significantly larger than that for the other 22 M31 and M33 novae in the dataset. Therefore the authors supposed that the Nova 1992-01 was probably a recurrent nova, which had a new unobserved outburst about 2001, responsible for the observed X-rays.

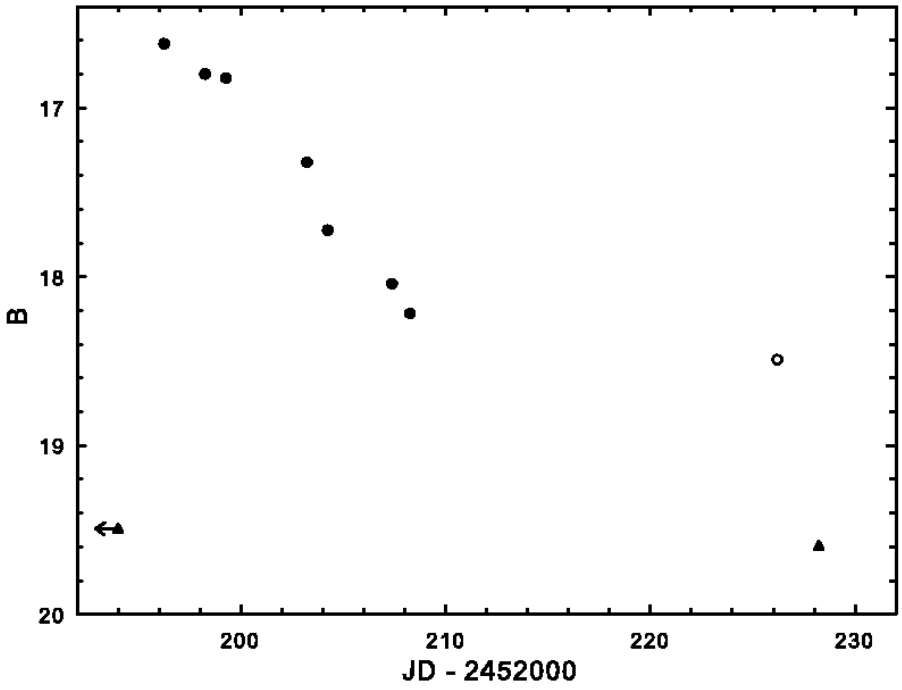

Figure 2. The light curve of the nova in M31. Filled circles: confident measurements; open circle: uncertain measurement; triangles: brightness upper limits (the triangle with arrow corresponds to JD 2452151.472)

To try to verify the possibility, that our reported nova and the Nova 1992-01 is the same object, we inspected Baldone observatory archival plates of M31 taken in 1992. We found the Nova 1992-01 on two 1/10/2001 photographs and measured its coordinates on both plates in the same way, as was done for the reported nova, and we got

$$\text{R.A.} = 00^{\text{h}}41^{\text{m}}53\overset{\text{s}}{.}82, \qquad \text{Decl.} = +41^{\circ}07'22\overset{''}{.}5 \qquad \text{(equinox 2000.0)},$$

with 1-sigma error of $0\overset{''}{.}3$.

The position separation between the Nova 1992-01 and our reported nova is $5\overset{''}{.}2$, thus they are different objects.

As the Nova 1992-01 lies $6\overset{''}{.}1$ apart from the X-ray source 191, but our nova at much smaller distance $0\overset{''}{.}9$, the latest must be considered as an optical counterpart of the X-ray source. In this case the time separation between the optical outburst and X-ray rise—84 days falls in the interval of time separation from 63 d to 170 d observed for four other novae—optical counterparts of X-ray sources in M31, contrary to the extraordinarily long 9 years time separation in case of previously assumed identification with the Nova 1992-01. To the common features of these short-time separation optical counterparts add the fact that three of them are fast novae in the same way as our nova.

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Corrigendum for IBVS 5720 In the paper by Smirnova & Alksnis (2006), third paragraph from the end, instead of 1/10/2001 should be 1/10/1992. Our thanks are due to W. Pietsch for pointing out this error.