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NEW VARIABLES IN THE NORTH-EASTERN PART OF M31

The north-eastern part of M31 has been poorly studied for variable stars in contrast to the south-western one. After the pioneering survey of Hubble (1929) which covered the entire body of the galaxy only 4 fields (each with a diameter of 16′) located at the different galactocentric distances along south-western major axis were studied for variable stars in details (Baade & Swope, 1963, 1965; Gaposchkin, 1962). Only one new 75-day cepheid has been added (Ivanov, 1985) in the north-eastern part since Hubble's times.

The main goal of this work is to look for new variables in the north-eastern part of M31. We used 15 plates (B passband, $40' \times 40'$ field) obtained at the 1 m telescope (f/13) of SAO RAN, Russia from 1990 until 1992. They are centered on $\alpha(1950) = 0^{\rm h}41^{\rm m}10^{\rm s}$ and $\delta(1950) = 41°17'$. This position was considered to include the larger part of the bulge of M31 which is the most probable area for discovering of novae and study of all four Hubble-Sandage variables in Andromeda nebula. The exposure time was usually 4 hours.

A separate calibration curve was constructed for each of our plates. We used 45 standard stars from the photoelectric sequences of Humphreys et al. (1987) and CCD measurements of Massey et al. (1986). The mean error of our calibration curves is about $0\overset{\rm m}{.}1$. The stars were measured with a constant slit photometer.

We selected 19 new variable stars candidates within the investigated area blinking 5 pairs. They were included in a list of 33 known or suspected variables together with previously known 14 variables within the same area. Their coordinates accurate to $\pm\, 0\overset{''}{.}5$ are given in Table 1. The identification chart for these variables is given in Figure 1.

Table 1. Coordinates of known and suspected variables in the NE part of M31

No.	$\alpha(1950)$	$\delta(1950)$	Points	Rem	No.	$\alpha(1950)$	$\delta(1950)$	Points	Rem
	h m s	° ′ ″				h m s	° ′ ″		
1	0 39 31.50	41 03 09.4	13		18	0 41 20.99	41 08 57.9	8	V 13
2	0 39 31.68	41 03 05.9	13		19	0 42 12.45	41 12 03.6	13	
3	0 39 41.01	41 03 17.4	12	V 4	20	0 42 14.54	41 07 17.5	13	
4	0 40 05.31	41 04 19.8	11		21	0 42 13.24	41 07 15.3	12	nova?
5	0 39 28.11	41 09 10.3	12		22	0 41 44.76	41 06 32.6	13	
6	0 39 47.81	41 12 42.2	13	I 1	23	0 41 34.93	41 06 18.3	12	V 15
7	0 40 24.16	41 12 45.7	8		24	0 41 20.03	41 01 50.8	12	
8	0 40 40.46	41 15 10.1	13		25	0 41 15.62	41 01 32.8	12	
9	0 40 36.39	41 20 08.4	7		26	0 41 15.63	41 02 35.9	8	V 6
10	0 40 58.90	41 27 36.7	10		27	0 41 02.69	41 03 09.2	9	V 14
11	0 41 26.65	41 20 31.1	13		28	0 41 00.65	41 00 40.8	11	V 11
12	0 41 06.64	41 18 59.9	4	V 9	29	0 41 32.15	40 57 02.5	9	
13	0 41 17.74	41 13 48.8	10	V 12	30	0 40 48.88	40 55 42.2	9	V 19
14	0 41 07.50	41 11 16.1	11	V 7	31	0 41 04.47	40 53 01.0	3	V 2
15	0 40 51.91	41 07 12.1	12		32	0 40 04.08	41 05 35.0	4	V 8
16	0 40 51.75	41 07 03.6	8		33	0 42 05.88	41 14 09.3	12	VA 1
17	0 41 14.11	41 08 34.9	12						

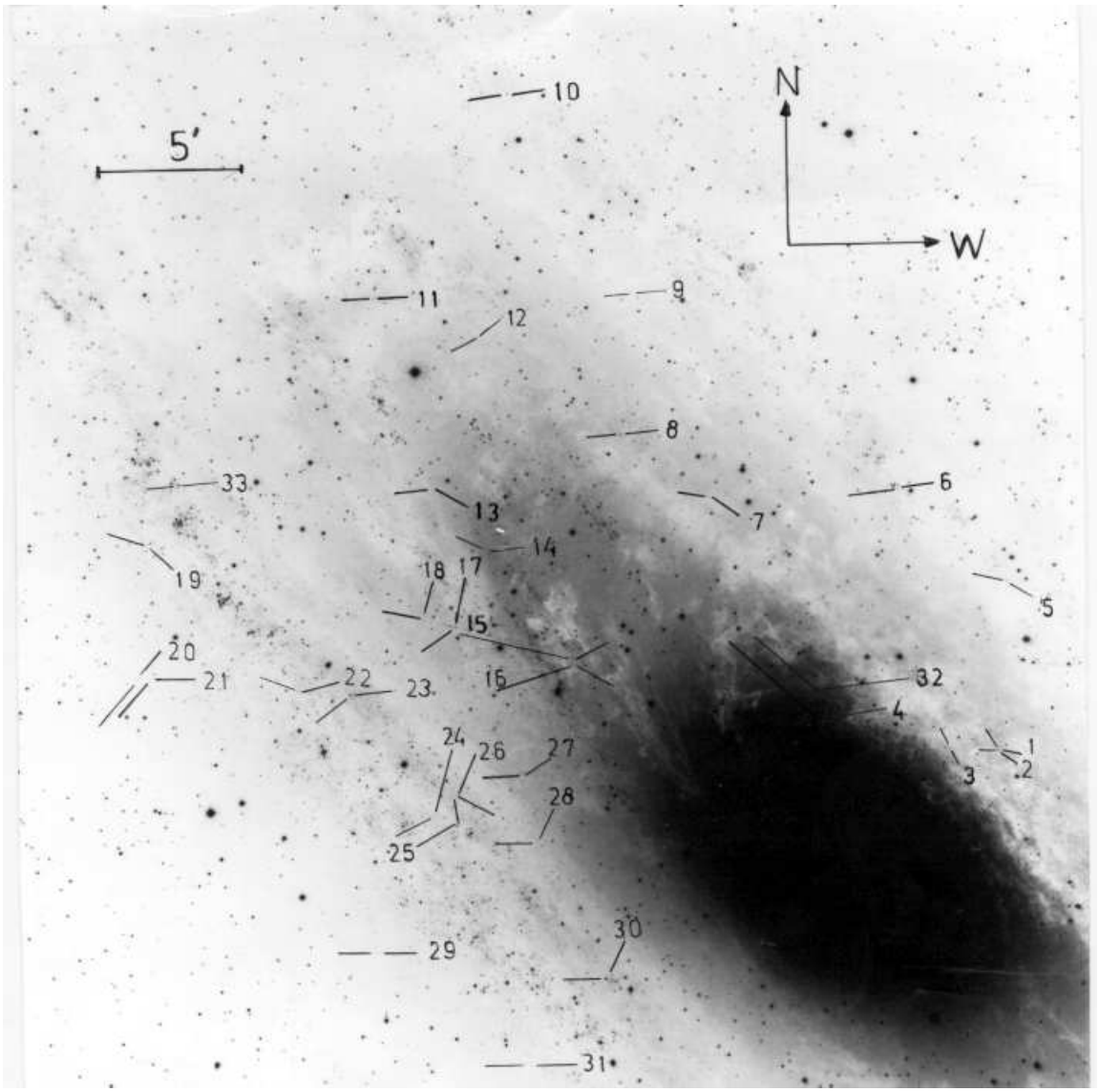

Figure 1

Table 2. Photometry of stars No. 2, No. 5 and No. 28

JD 2 440 000+	No. 2	No. 5	No. 28
8156.5260	19.73	19.10	20.39
8531.4896	19.63	19.28	20.99
8536.4618	19.44	—	20.68
8537.4375	19.67	19.51	20.80
8539.4375	19.49	19.17	20.95
8542.4583	19.78	19.27	21.32
8572.3542	20.15	19.12	—
8649.3767	19.52	19.17	21.21
8650.3577	19.99	19.42	—
8831.6177	19.89	19.21	20.82
8832.5823	19.84	19.11	20.92
8837.6250	20.32	18.61	20.67
8839.6215	20.02	18.85	20.43

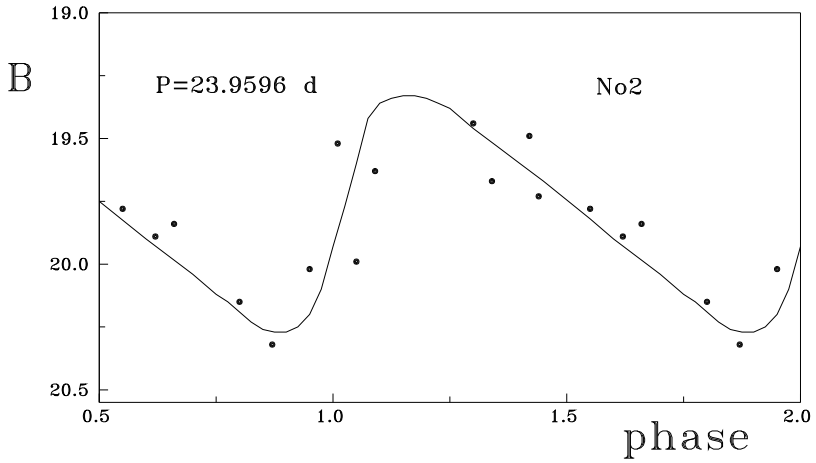

Figure 2. Light curve of star No. 2

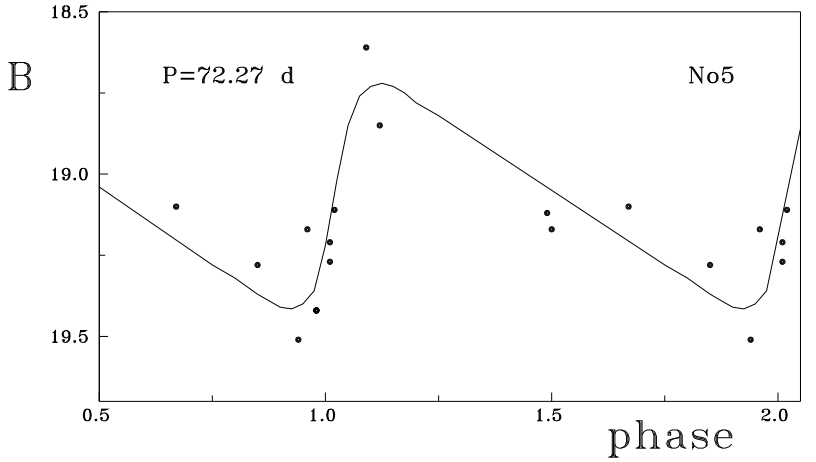

Figure 3. Light curve of star No. 5

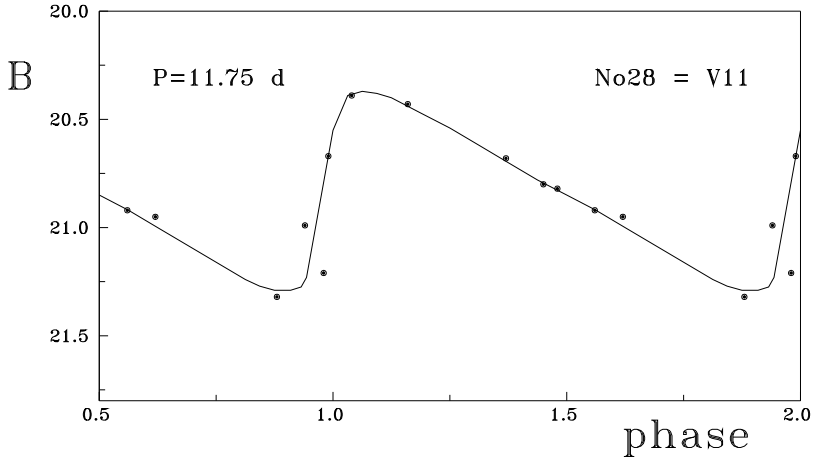

Figure 4. Light curve of star No. 28

Our measurements show that practically all the suspected variables show measurable change in brightness (amplitudes greater than $0\overset{m}{.}7$) but only for 14 of them we can present a list with more than 11 points of observation. A period-finding programme was applied to obtain the appropriate periods. For three of these stars acceptable light curves were found. Photometry of these stars is presented in Table 2.

Figures 2-4 show computed light curves with obtained periods. Luminosities of these variables coincide with the values predicted by the period-luminosity relation for the cepheids in M 31. The star No. 28 was classified from Hubble (1929) as an irregular variable.

The limiting magnitude of our plates prevents us from reaching the levels more populated by cepheids. Most of the known and suspected variables are found out of the boundaries of the OB associations.

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