SIGNS OF INTERACTION OF THE NGC 1275 NUCLEUS WITH THE HIGH-VELOCITY SYSTEM ACCORDING TO 0",7 SEEING OBSERVATIONS

V. N. Dudinov and V. S. Tsvetkova
Astronomical Observatory of Kharkov University, USSR

S. B. Novikov
Sternberg State Astronomical Institute, USSR

I. I. Pronik
Crimean Astrophysical Observatory, USSR

ABSTRACT. The nucleus of the Seyfert galaxy NGC 1275 was observed in the B system on 12-1-1989 with seeing 0",7 using the Zeiss-1000 telescope on Mount Majdanak in Central Asia. Special methods of processing reveal low-contrast details. The nucleus and circumnucleus are stretched in NW-SE direction. There are two narrow filaments near the nucleus in position angles roughly 340° and 320°. The first is directed near the radio jet of the nucleus, the second has broken details curved to the NW or toward the high-velocity system of NGC 1275.

The NGC 1275 system consists of a main gE galaxy, having a radial velocity 5200 km/s (Burbidge, Burbidge 1965) and of an irregular galaxy (L-galaxy - late type spiral) with radial velocity 8200 km/s, located to the NW of the main one (Minkowski, 1957). Both galaxies are rich in gas. The gas of the main

galaxy looks like a giant Crab, or burst, of dimensions equal to those of the gE galaxy (Burbidge, Burbidge 1965; Lynds 1970). The nature of the L-galaxy is widely discussed. The first discoverer of this galaxy, Minkowski, supposed that it is colliding with the gE one. The Burbidges (1965) discussed the ejection of L from gE galaxy, Shields and Oke (1975) and van den Bergh (1977) supposed that L-galaxy is projected to the gE galaxy. The colliding hypothesis is favored from HI observations of L-galaxy in the 21 cm Hl line found in absorption against the radio continuum emission of the NGC 1275 bright nucleus (de Young et al., 1973). In all hypotheses there are intrinsic difficulties. The important problem up to now is how the two galaxies interact and whether the interaction exists or not. One supposition about the site of interaction was made by Metik and Pronik (1979): near the starlike object located 7" NE from the NGC 1275 nucleus (later object "b"). Meaburn et al. (1989) supposed that interaction produces a fine filament of optical continuum emission with ionized knots along its length presented in PA = 295°. For further discussion of this problem it is important to reveal the details of the nucleus and circumnucleus of NGC 1275.

The Burbidges were the first to discover irregularity in the structure of the NGC 1275 nucleus (1965): they pointed out a knot 3" to the NW of it (later detail "c"). Metik and Pronik (1979, 1984, 1987, 1988, ab,b) showed that the circumnuclues is stretched in the direction of this arched detail "c" in UV continuum and in 14 emission lines. This stretched structure

consists of blue stars and gas. Its direction is very near to the radio jet one (Pedlar et al., 1983). It was supposed that active nucleus of NGC 1275 interacts with the circumnucleus through this stretched structure. Now new details of circumnuclear region of NGC 1275 are obtained using photonegatives with resolution $0''.7$.

Observations were made 12-1-89 on mountain Majdanak in Central Asia with $0''.7$ seeing using the Zeiss-1000 telescope. Six negatives with 15 min exposure were obtained in the B photometric system. Figure 1 shows a print of one of the negatives. One can see the nucleus "a", starlike object "b" and stars - photometric standards: C, C1, C2, C3, 1, 2 - from Lyutyi's list (1972), D, D1, D2, D3, D4 - secondary standards, obtained by extrapolation. All measurements were made with an iris photometer. The results are shown in Table 1.

Table 1. B magnitudes of nucleus "a" and object "b" and secondary standards near the nucleus of NGC 1275

detail, star	B	star	B
a	15,75±0,08	D2	15,56±0,05
b	16,33±0,01	D3	16,16±0,10
D	14,05±0,05	D4	16,41±0,10
DI	15,83±0,08		

The magnitude of object "b" is in accordance with Selove's estimate $B = 16^m.3$ (1969). The magnitude of nucleus "a" obtained from its photometric profile in a circle of 2" diameter is $15^m.63$ very near to Table 1's value. According to Lyutyi (1991)

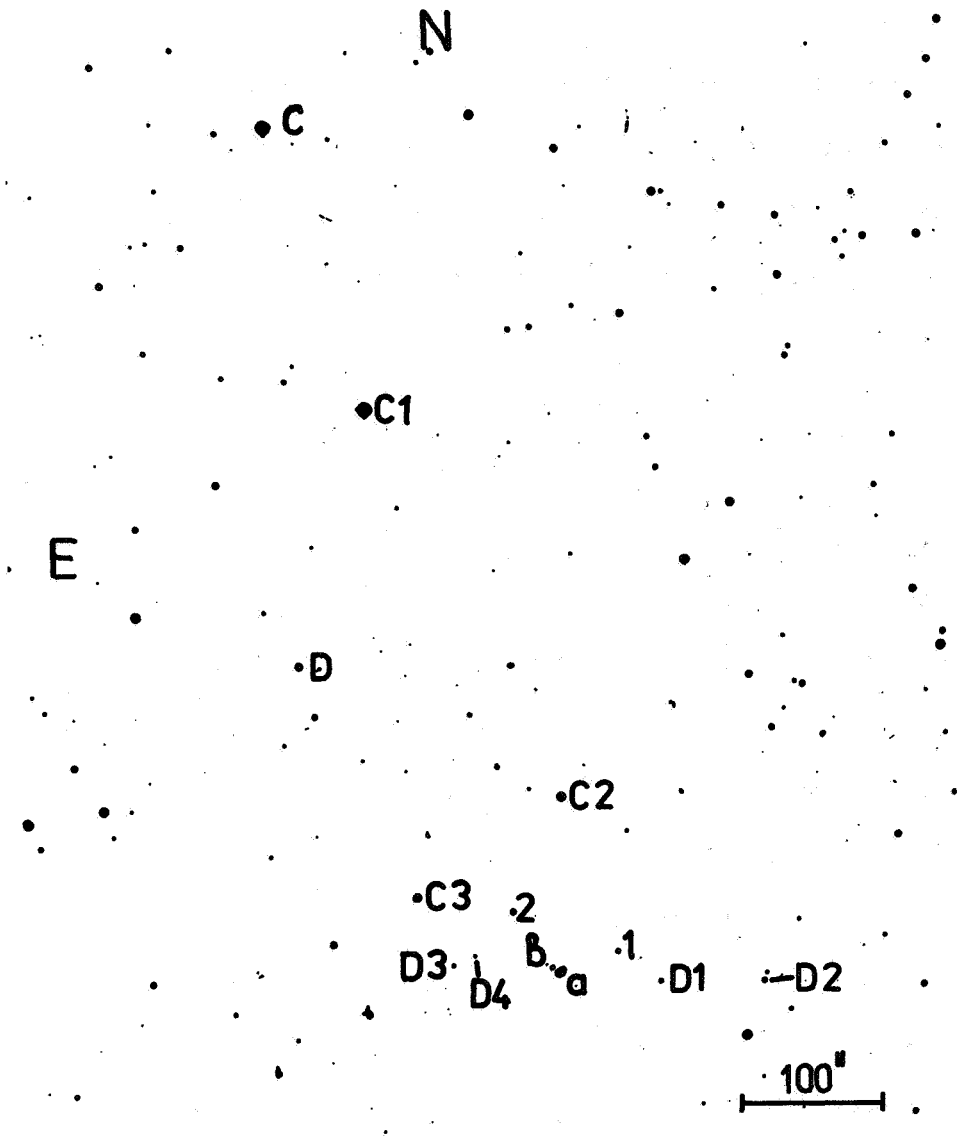

Figure 1. Photo of the NGC 1275 region in the B photometric system, obtained with the Zeiss-1000 telescope on Mount Majdanak 12-1-89. The photometric standards are pointed. a - circumnucleus, b - starlike object (see text).

the active nucleus of NGC 1275 galaxy has been in a deep minimum from 1980 up to now. Observations made by Zasov and Lyutyi (1973) in 1967-1970 give $B(5") = 14^m,61$. Now on February 1988 and October 1989 Lyutyi's data give $B(5") = 15^m,74: - 1^m,13$ weaker than in years of the nucleus' high activity. The dimension of the nucleus also decreases. Obtained in 1977 it was $\sim 1",5$ (Metik, Pronik, 1984). Nowadays the dimension of the nucleus was

calculated using $0''.7$ resolution observation on 12-1-89. Taking into account that the brightness distributions in the images of objects "a" and "b" are near to Gaussian the dimensions of the objects can be calculated using the relation:

$$\sigma_0^2 = \sigma_t^2 + \sigma_s^2$$

here σ_0^2, σ_t^2, σ_s^2 are dispersions of observed, true and stellar photometric profiles respectively. Object "b", to the limits of the errors, is not distinct from the star. The true FWHM of the nucleus is $0''.5$. Thus with the decreased level of nuclear activity its dimension decreased too.

The best negatives available (for stellar FWHM = $0''.7$) were taken for special processing. All negatives selected were added with the help of optical combining equipment. The combined positive was put for linear filtration using the optical coherence arrangement of Kharkov University (Dudinov et al., 1979, 1989; Tsvetkova et al., 1984).

Figure 2 shows the photo of the circumnucleus of NGC 1275 obtained after summed image filtration. Weakening of the nucleus, high spatial resolution and special processing methods permit us to reveal new details in the circumnucleus of NGC 1275. In addition to arch "c" there are structures connecting it with the nucleus and structures in opposite SE side. Figure 3 shows isophotes of this region obtained with scanning step $0''.25$.

Figures 2 and 3 show that nucleus of NGC 1275 is stretched in the NW-SW direction at all intensity levels from 0.9 to 0.2.

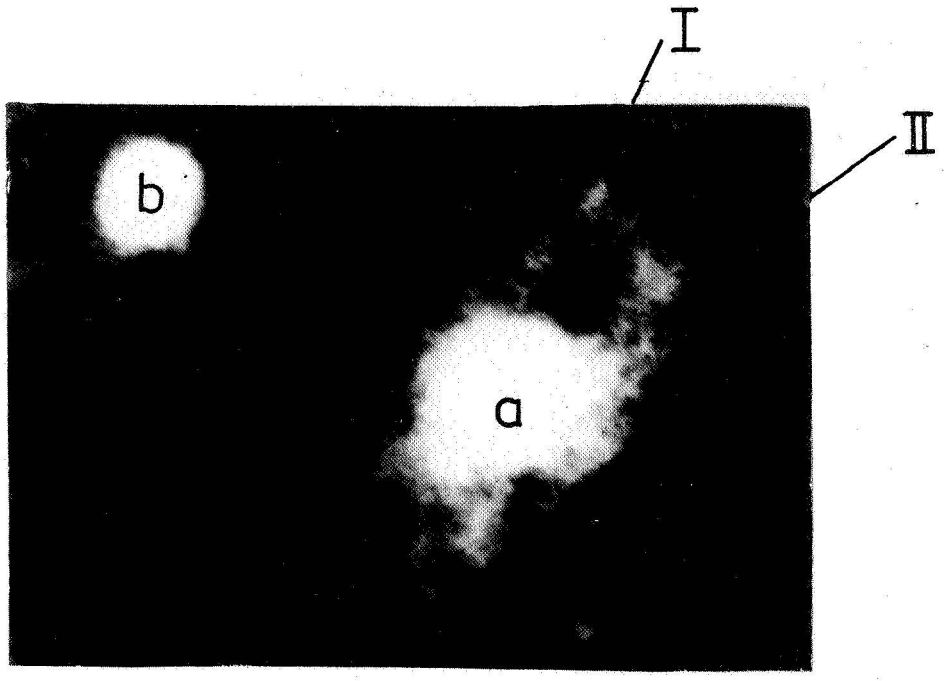

Figure 2. Photo of the circumnucleus of NGC 1275 and object "b" after spatial processing. I, II - filaments of low intensity emission.

I_{max} and this stretching is observed to the distances ±5" or ±1800 pc from the nucleus. The stretched circumnucleus measuring 3".5 or 1200 pc is divided into two streams in its NW part: I - in PA ~340°; II - in PA ~320°. The first has an extension to the SE side of the nucleus. Its PA is very near the PA of the nuclear radio jet observed at 73 cm (Pedlar et al. 1983). The second filament (II) has no continuation on the SE side of the nucleus. It envelops the nucleus from the W side by many little curved streams, the longest of them near the PA 300 of gas knots observed by Meaburn et al. (1989) and the direction of the L-galaxy. Arch "c" connects filaments I and II in the NW part. Its brightness is not homogeneous. The extended weakest

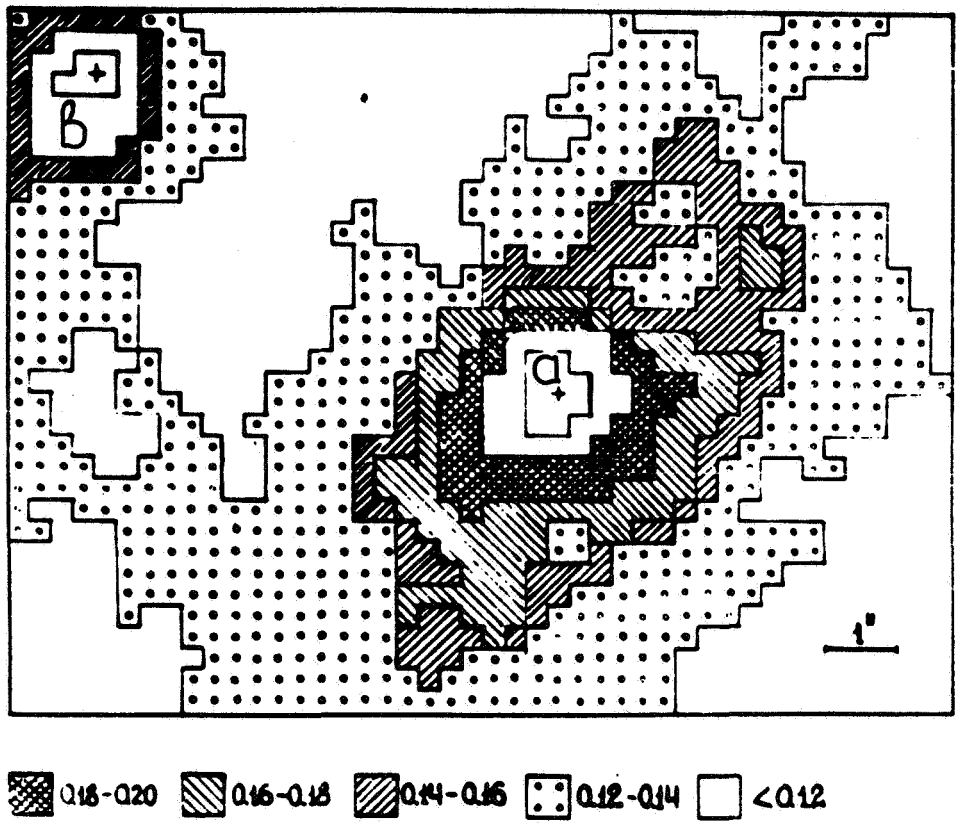

Figure 3. Isophotes of circumnucleus of NGC 1275. Step of scanning is 0.25. Intensities are in units of I_{max} of the nucleus.

emission of the level < 0.2 I_{max} (of the nucleus) on SE side has a curved jut directed to object "b" which, at low intensity levels, has emission directed to this feature.

What may be the nature of filaments I and II of Figure 2 and 3? In the B photometric system the lines [OII] and [OIII] of the low and high velocity gas are passed. So it is not necessary to suppose, that filaments I and II consist but of stars, but they may contain gas of low and high velocity. Spectral investigation (Metik, Pronik, 1979) shows that arch "c" is a superassociation of early-type stars of dimension ~1000 pc. It is rich in gas and

belongs to the low-velocity system. The spectra of the SE stretched part of the NGC 1275 circumnucleus also show gas of low and partly high velocity. For the interpretation of filaments I and II it is important to observe their spectra with high spectral and position resolutions.

In conclusion one can say that photo of NGC 1275 circumnucleus obtained with spatial resolution 0".7 in B shows signs of interaction with: I - the radio jet, 2 - knots of gas observed by Meaburn et al. (1989) on the NW side of the nucleus and 3 - object "b". The most prominent interaction is with the radio jet. Interactions 2 and 3 are at lower levels.

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