UV GALAXIES

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1. INTRODUCTION

The systematical statement of the concept of the activity of the nuclei of galaxies was first made public by Ambartsumian about 25 years ago (Ambartsumian 1958, 1962, 1965). Since 1965 he has been advancing and developing the idea of the basic role of the nuclei of galaxies in their life and evolution.

According to Ambartsumian the "activity" of the nuclei of galaxies manifests itself mainly in the following forms:

1. Outflow of ordinary gas matter (in form of jets or clouds) from the nuclear region at the velocity of up to hundreds of kilometres per second.

2. Continuous emission of the flux of relativistic particles or other agents, producing high energy particles, as a result of which a radio halo may form around the nucleus.

3. Eruptive ejections of gas matter (M82 type).

4. Eruptive ejections of concentrations of relativistic plasma (NGC 4486, 5128, etc.)

I should like to emphasize on the form of activity which says:

5. Ejection of compact blue condensations with an absolute magnitude of the order of luminosity of dward galaxies (NGC 3561, IC 1182). Here the division of the nucleus into two or more comparable components is also presumed; initiating the formation of multiple galaxies.

Richard M. West (ed.), Highlights of Astronomy, Vol. 6, 459–466.

Below I shall speak more in detail about this form of activity.

Now it is well known that there are a large number of galaxies with active nucleus. But I am going to discuss UV galaxies only.

These galaxies (altogether about 2000), discovered in Byurakan Observatory by Markarian (Markarian 1967) and Kazarian (Kazarian 1979), have one common characteristic: more or less strong ultraviolet excess on the objective prism spectra, obtained with 40" Schmidt telescope.

As far back as 1968 I have demonstrated that slit-spectra of UV galaxies can be divided into five groups:

1. Narrow lines both in emission and absorption.

2. Narrow, strong emission lines only.

3. Strong and diffuse emission lines; (OIII) lines much stronger than the hydrogen lines (Seyfert type 2).

4. Very broad hydrogen lines, narrow forbidden lines (Seyfert Type 1).

5. No strong emission lines. (Khachikian 1968).

In other words, we can write the following scheme:

UV GALAXIES

Similarities: UV excess (more or less).

Differences: Spectroscopy: quite different spectra, which may be placed in five groups; morphology: quite different types (ellipticals, spirals, Irr, Haro & Zwicky galaxies, QSO's).

It became recently clear that among UV galaxies there are objects with double nuclei (Khachikian, Petrosian and Sahakian 1978). Very close to them stand such UV galaxies, which are distinguished by a very interesting and unusual structure and dynamic peculiarities (Markarian 7,8,281, Kazarian 5 = NGC 6306). Their central regions contain bright condensations with different radial velocities (Khachikian 1972, Khachikian & Kazarian 1977). The condensations are in reality superassociations or, as they are frequently termed in literature, giant H II regions. For instance, the brightest condensation in Markarian 8 has

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$M_{pg} = -18^m$ (Khachikian 1972).

Recently the spectral observations of some double-nuclei UV galaxies have been carried out in the prime focus of 6 m telescope of the SAO of the USSR Academy of Sciences with the SP-160 spectrograph and image tube (dispersion about 65 A/mm), (Khachikian, Petrosian and Sahakian 1979a). The observations show that both nuclei are not always spectroscopically identical and sometimes differ markedly both in the intensity of the continuum and the lines. Interestingly, Seyfert galaxies are also met with among double nuclei galaxies (Markarian 266, 463, 673, 739, 789), (Khachikian, Petrosian & Sahakian 1979b and 1980). It is very important, that among them there are galaxies in which both nuclei show seyfert-type spectra. On the following table the apparent and absolute photographic magnitudes (rough estimation) of the components of the nucleus, distances between components in arc. seconds and kpc, radial-velocity differences are presented (H = 75 km/sMpc).

Mark N°	m_{pg}	M_{pg}	d"	d kpc	v_r km/s
266	17.5	-17.8	12	6.5	127
	17.8	-17.5			
273	17.5	-18.4	4.3	3.2	-
	18.2	-17.7			
463	17.0	-19.5	4.5	4.3	50
	17.2	-19.3			
673	16.2	-19.6	5.3	3.7	166
	16.2	-19.6			
739	16.2	-19.1	6.6	3.8	85
	17.0	-18.3			
789	16.0	-19.5	4.1	2.5	2
	18.0	-17.5			

The existence of galaxies with two condensations in centrum having seyfert-type spectra (Markarian 266, 463, 673, 789) is established as an evidence of the possibility of the existence of galaxies with double nuclei in general.

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Fig. 1 and 2 give the pictures of isodenses of Markarian 266 and 463, and their spetra. One can see that both components of both galaxies have Sy2 type spectrum. Fig. 3 gives the spectrum and its tracing of Markarian 739. One of the nuclei has Sy1 type spectrum, the other has a spectrum which reminds the spectrum of a superassociation.

The measurements of spectral lines of nuclei of Markarian 266 show that they rotate in different directions with the velocities 132 km/s ("a" nucleus) and 286 km/s ("b"), (see Fig. 1). According to this the mass of "a" nucleus is about 7 x 10^9 Solar masses and "b" - 3.3 x 10^{10} Solar masses.

It is necessary to note here about the very peculiar objects - "twins" near Markarian 261 and 262, which are in reality just nuclei of galaxies without any diffuse envelope. A notable peculiarity of these objects is their great similarity: appearances, dimensions, luminosities, radial velocities and especially the spectra with bright and narrow emission lines (Arp, Heidmann & Khachikian 1974).

In this way we can write the following scheme:

Double nuclei GALAXIES

Similarities: 1. UV excess. 2. Morphology of the central regions. 3. Identical emission lines in the spectra. 4. Both nuclei are Seyfert type.

Differences: 1. Type of spectrum. 2. Brightness of the continuum and emission lines. 3. Intensity-ratio of emission lines. 4. Absolute brightness of the nuclei.

All of this observational data confirms that the central regions play a basic role in the activity of the galaxies. The activity depends to a much lesser exten on the morphology of the otuer parts of the galaxies. On the other hand, the external form of the nucleus is not a factor that can determine the manifestation of one form of activity or another.

To illustrate the above statement let us quote the following examples (Khachikian 179). Markarian 9 is a compact star-like galaxy, while Markarian 10 is a giant spiral galaxy with dimensions about 55 kpc (Khachikian 1970). In spite of this difference in morphology, however, they are both Sy1 galaxies. If we compare, however , two spiral galaxies with very bright and star-like nuclei, Markarian 10 and Kazarian

73, we see that they differ sharply in activity: Kazarian 73 has narrow but bright emission lines, while Markarian 10 is Sy1 galaxy. At the same time very compact and star-like object Markarian 305 is not only a non-Seyfert galaxy but lacks emission lines, in general (Khachikian 1976).

Thus we see clearly that the star-like objects, either the nuclei of spirals or the "bare" nuclei, display quite different forms of activity.

The same statement is correct for the double nuclei UV galaxies. There are double nuclei galaxies with different morphologies, for example, Markarian 19, 273, 463, 799 etc. (Khachikian, Korovyakovskij, Petrosian & Sahakian 1981). At the same time, as has been shown above, they differ sharply in activity.

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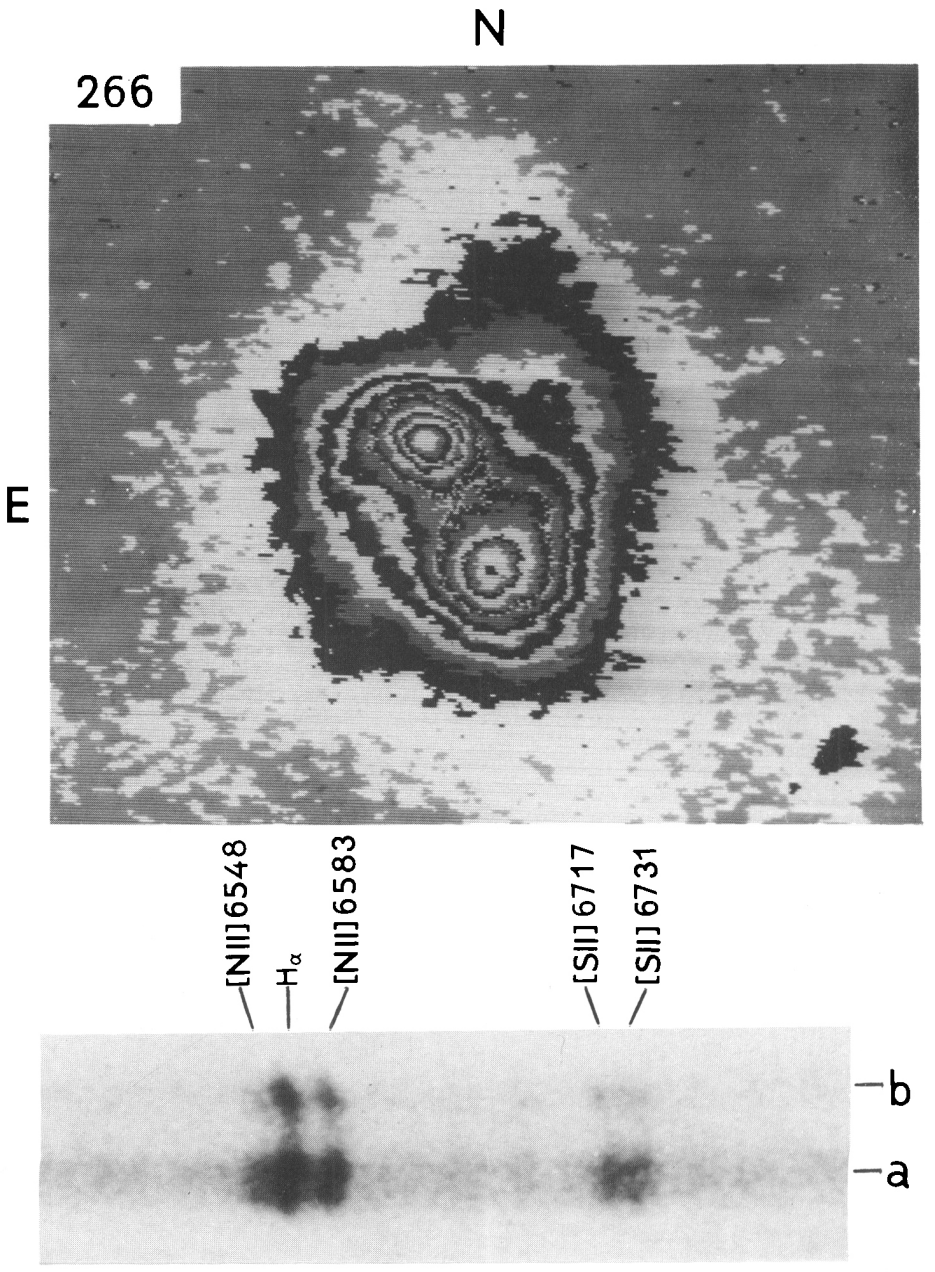

Fig. 1. Isodenses (2.6 m telescope of Byurakan Observatory, 1 mm = 0".6) and spectrum (6 m telescope) of Markarian 266.

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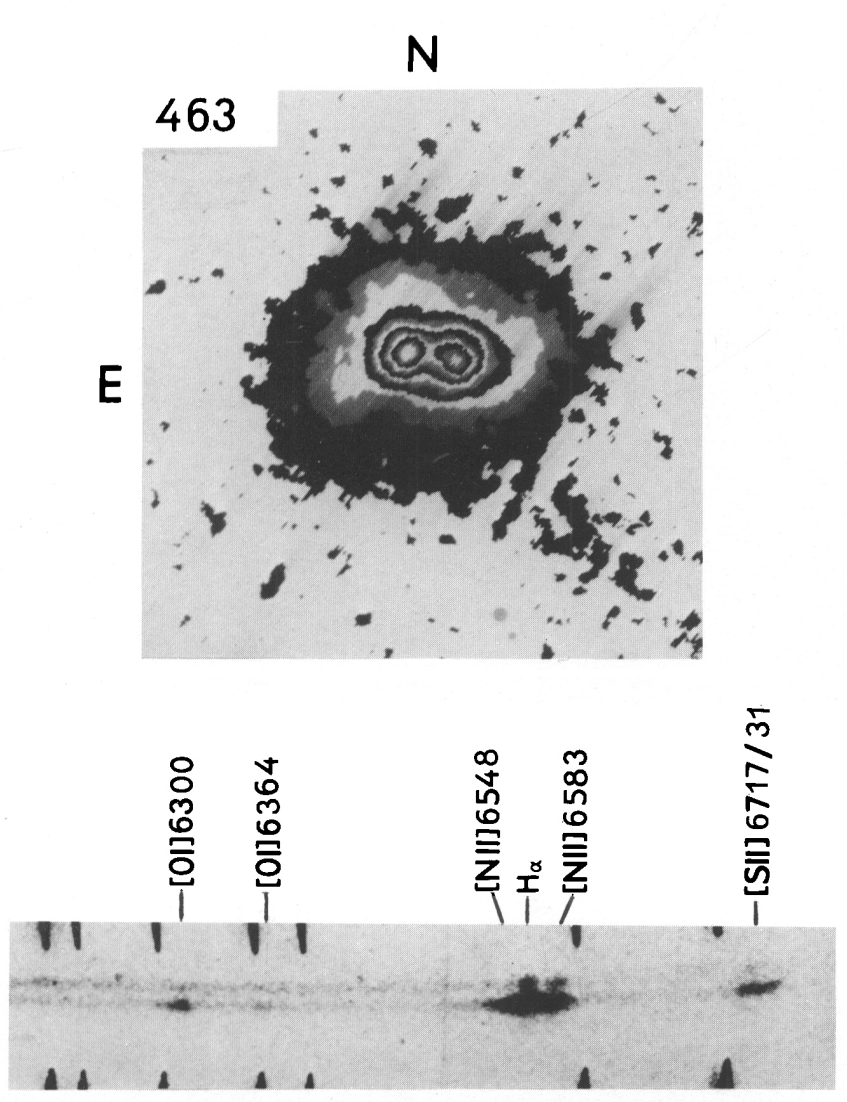

Fig. 2. Isodenses (2.6 m telescope of Byurakan Observatory, 1 mm = 0".6) and spectrum (6 m telescope) of Markarian 463.

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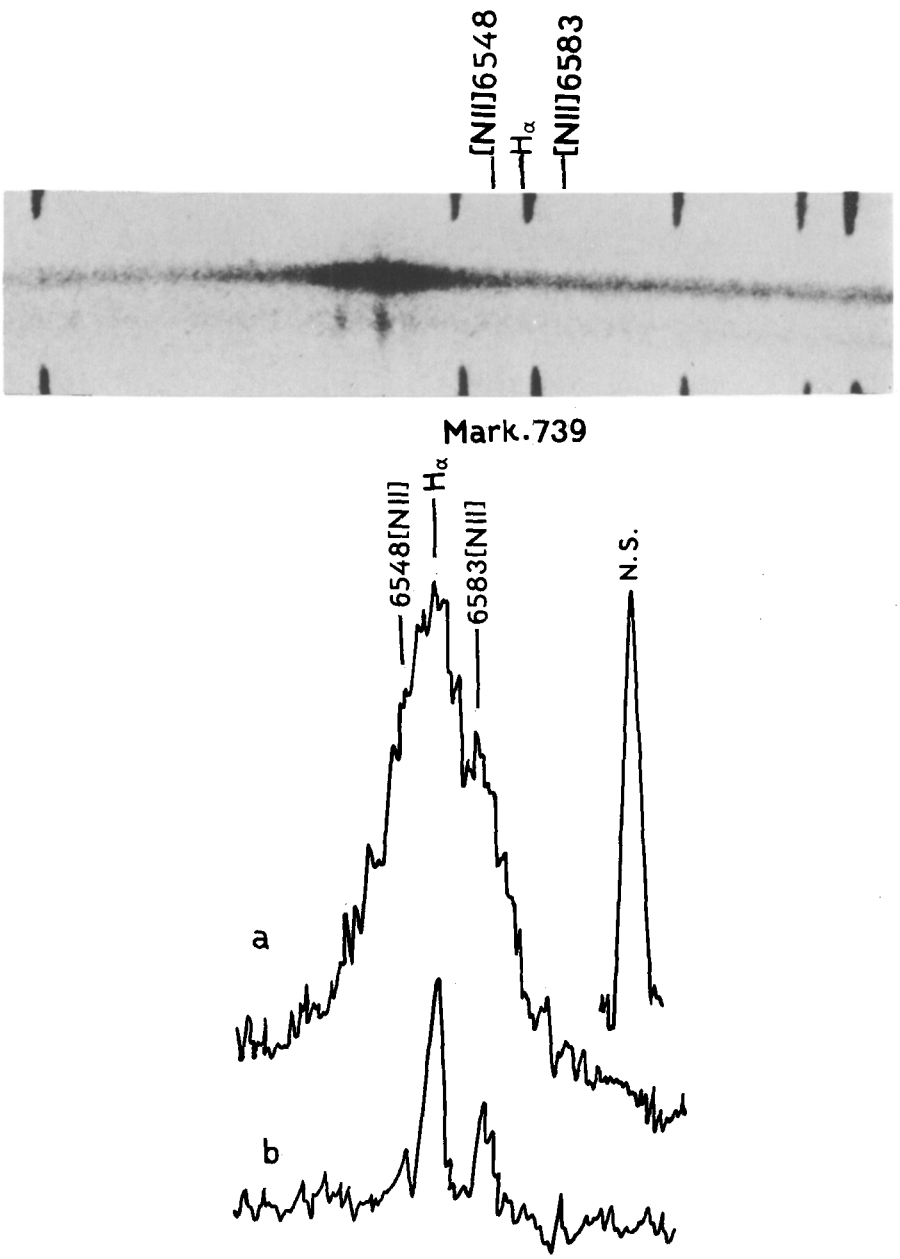

Fig. 3. Markarian 739: spectrum and its tracing.

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