SECTION II

ULTRAVIOLET EXCESS GALAXIES

E.Ye. Khachikian

UV-GALAXIES

E. Ye. Khachikian
Byurakan Astrophysical Observatory
Armenia
USSR

1. INTRODUCTION

At the present time the previously used term "Peculiar galaxy" is gradually being replaced by the term "active" galaxy. This is quite natural, because the overwhelming majority of "peculiar" galaxies turned out to be "active" at the same time. The opposite is not correct: there are a lot of examples where a galaxy looking normal is physically active.

The term "active" galaxy describes the object more clearly than "peculiar" galaxy. The latter is usually used for the galaxies which according to their morphological properties differ from the given morphological type. Besides, it is not classified, but is only declared different from "normal".

Although some authors refer to "active" galaxies as "unusual" (Komberg 1976), or "peculiar" (Vorontzov-Veljaminov 1972), and others call "active" all galaxies which are not normal (Brecher 1976), the term "active" galaxies is now coming into practical use everywhere and V. Ambartsumian was the first who introduced it into astronomy. I would like to remind you that according to Ambartsumian the "activity" of the nuclei of galaxies manifests itself mainly in the following forms (Ambartsumian 1956, 1958, 1962):

- Outflow of ordinary gas matter (in form of jets or clouds) from the nuclear region at the velocity of up to hundreds of kilometers per second.
- 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.
- Eruptive ejections of gas matter (M82 type).
- Eruptive ejections of concentrations of relativistic plasma (NGC 4486, 5128, etc.).
- Ejection of compact blue condensations with an absolute magnitude of the order of luminosity of dwarf 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. The presence of one or several of these phenomena

E. Ye. Khachikian et al. (eds.), Observational Evidence of Activity in Galaxies, 65–79.

https://doi.org/10.1017/S0074180900154920 Published online by Cambridge University Press

allows us to call a galaxy active. At present a number of types of objects are considered as active: radio galaxies, QSOs, Seyfert galaxies, Lacertides, UV-excess galaxies, blasars, liners.

I would like to talk about some problems concerning UV-excess galaxies (UV-galaxies).

2. UV-GALAXIES

In 1956 Haro discovered 44 galaxies unusually blue in colour with strong UV continuum (Haro 1956). The spectroscopy of these objects showed that they are galaxies with strong emission lines. Actually, Haro marked the beginning of the quest for blue galaxies. At the same time the Byurakan Observatory also engaged itself in the activities aimed at discovering galaxies with active nuclei. Ambartsumian and Shahbazian were the first to show the existence of blue ejections and condensations connected with active elliptical galaxies by means of filaments. They found a number of low luminosity blue galaxies (Ambartsumian and Shahbazian 1957, 1958).

Subsequently, Stockton (1968, 1972) showed that those objects are in fact associated with galaxies and display emission spectra similar to the superassociations and Haro blue galaxies. It was natural to try to find more blue galaxies among weak ones.

Then on the initiative of V.A. Ambartsumian, B.E. Markarian started in Byurakan in the mid-sixties observations of the sky with a view to detecting galaxies with anomalous spectra, using the 40" Schmidt telescope with an objective prism of the same diameter.

We have already heard the talks about the lists of Markarian objects, so I am not going to give their definition.

I would just like to emphasize once more that the detailed spectral investigations of these objects indicated (Khachikian 1968; Weedman and Khachikian 1968, 1969) that over 85% of them turned out to have emission lines, their intensity being directly dependent on the value of UV-excess. One can conclude that the presence of a strong ultraviolet continuum is closely associated with the formation of the emission spectrum and the more intense the continuous spectrum in the visible ultraviolet is, the more intense are the emission lines.

As far back as 1968 I also demonstrated that on the basis of slit-spectra, UV galaxies can be classified in five groups (Khachikian 1968):

1. Narrow line spectra 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.

No new type of spectra of UV galaxies has since been observed, except for galaxies with pure absorption line spectra (Sargent 1970).

The most important is that 10% of Markarian objects turned out to be Seyferts. One can say that a considerable part of UV galaxies is already studied spectroscopically. At least the redshifts of all objects having lines are determined. As for the photometry of UV galaxies and specially detailed photometry there are very few works. I can just note some of them: Khachikian and Weedman 1971; Khachikian 1972; Khachikian and Sahakian 1975; Adams 1977; Barbieri et al. 1979.

On the other hand, the detailed photometry gives us a better possibility to understand the nature of them. In favour of the importance of the detailed photometry speak the works of Australian astronomers concerning the photometry of ellipticals changing our notions about them and the fantastic job of radioastronomers who gave us beautiful pictures of radioisodensities of the central parts of active galaxies with resolutions of milliseconds of arc.

3. OPTICAL MORPHOLOGY OF UV-EXCESS GALAXIES

Actually, the first morphological description of UV galaxies was made by Markarian. But he used the Palomar survey maps with their small scale and very often was far from reality, especially for the central parts of galaxies.

As far back as 1969 Dr. Weedman and I noticed that UV galaxies do not form a homogeneous group of galaxies and among them there are many different types of galaxies from Zwicky's objects up to Seyferts (Weedman and Khachikian 1969).

It seems to me that we have to distinguish the morphology of UV objects in general, and morphology of their central parts in particular.

I showed in 1979 that the form of activity is not correlated with the morphology of the whole galaxy (Khachikian 1979). It is clear now that among active galaxies there are all representatives of the Hubble diagram. So, the most important is the problem of morphology of central parts of UV galaxies. Up to now I can distinguish the following groups:

a) starlike galaxies (Mark.9, 64, 205, 305; Kaz.102) (fig.1);
b) starlike nucleus (Mark.6, 10, 42, 474; Kaz.26, 73) (fig.2);
c) double nuclei galaxies (Mark.212, 266, 463, 673, 739; Kaz.347) (fig.3);
d) galaxies with jets (Mark.273, 423, 984; Kaz.4) (fig.4);
e) multinuclei or multicondensation galaxies (Mark.7, 8, 35, 325; Kaz.5) (fig.5).

There is also a group of galaxies with bulges (fig.6) but detailed large-scale study may put them into one of the groups classified above. Therefore, we do not classify them in a special group.

Clearly, the classification of a galaxy in any of these groups depends not only on the galaxy itself but also on the size of its image on the plate and the resolution. Nevertheless, we have good examples of these groups among UV galaxies. Let us consider each of these groups separately.

a b c

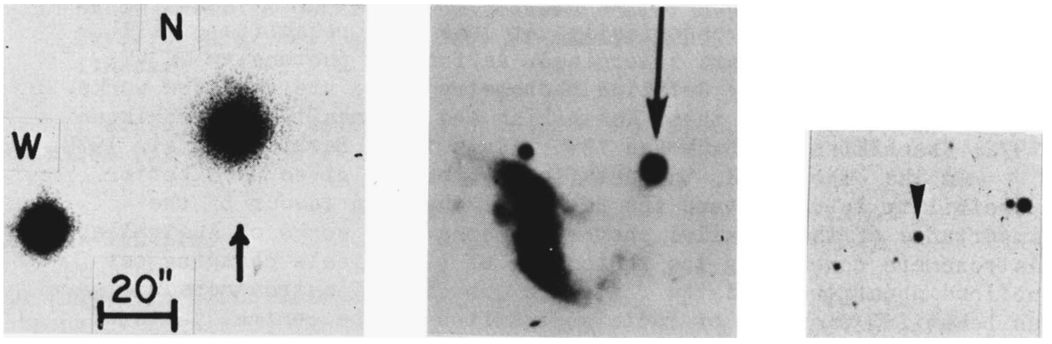


Fig. 1. Star-like galaxies
a) Mark.9; b) Mark.305 (1 mm ~ 1".6);
c) Kaz.102 (1 mm ~ 5".8)

a b c

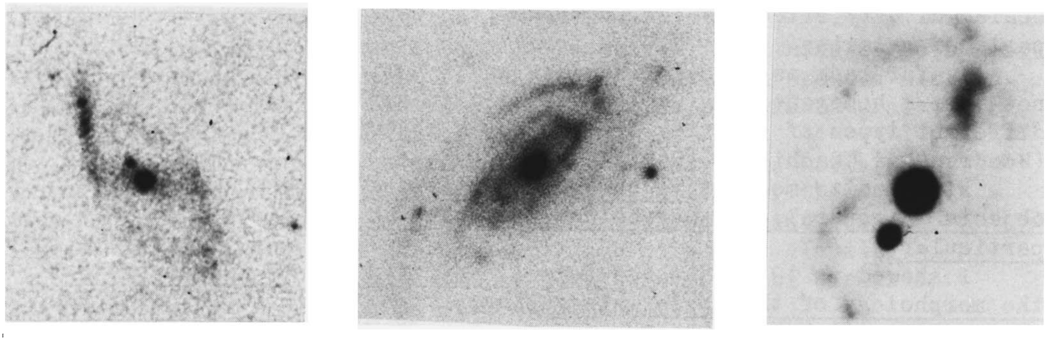


Fig. 2. Star-like nucleus galaxies
a) Mark.4 (1 mm ~ 2"); b) Mark.10 (1 mm ~ 2");
c) Kaz.73 (1 mm ~ 1")

a b c

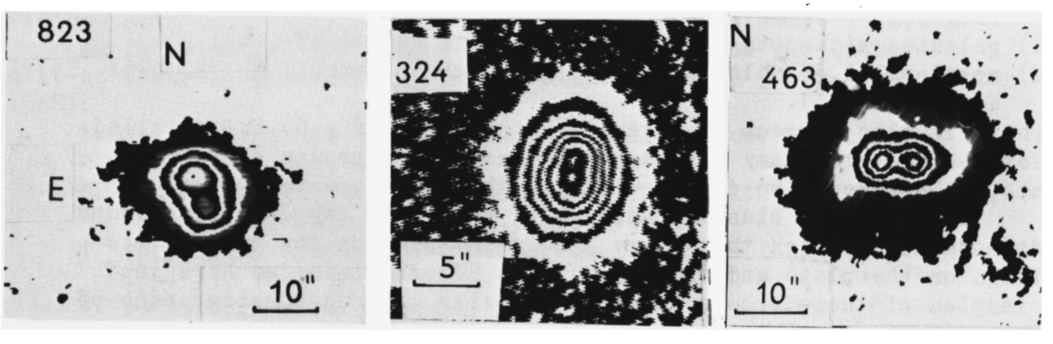
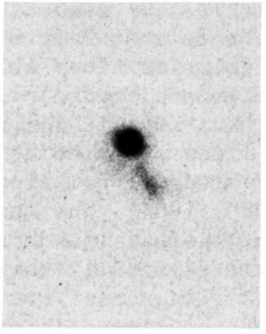


Fig. 3. Isophotes of double nuclei galaxies
a) Mark.823; b) Mark.324; c) Mark.463

https://doi.org/10.1017/S0074180900154920 Published online by Cambridge University Press

a

b



c

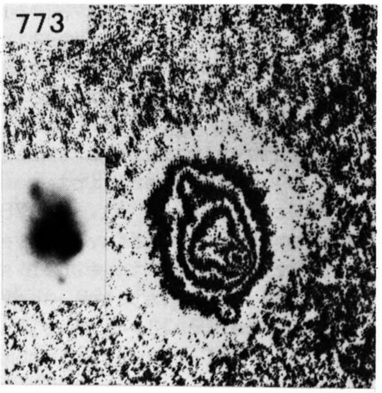
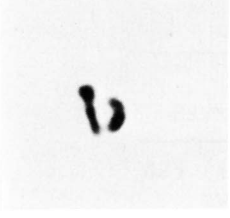
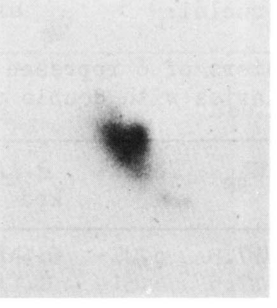


Fig. 4. Galaxies with jets
a) Isophotes of Mark.273 (1 mm ~ 1".0);
b) Mark.423 (1 mm ~ 1".4); c) Mark.773 and its isophotes (1 mm ~ 1".8 on the photo)

a



b



c

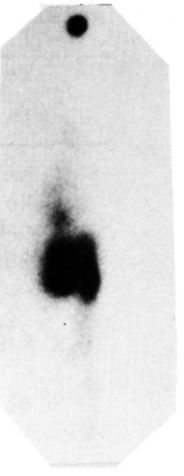
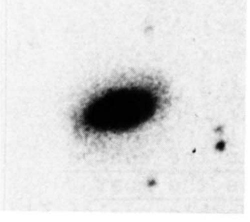
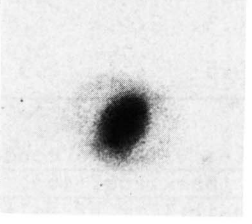


Fig. 5. Multinuclei or multicondensation galaxies
a) Mark.8 (1 mm ~ 2".7); b) Mark.35 (1 mm ~ 1"); c) Kaz.5 (1 mm ~ 1")

a



b



c

Fig. 6. Galaxies with bulges
a) Mark.1 (1 mm ~ 2".5); b) Mark.474 (1 mm ~ 1".8);
c) Mark.489 (1 mm ~ 4")

https://doi.org/10.1017/S0074180900154920 Published online by Cambridge University Press

a) These galaxies consist of a starlike nucleus with a very weak and small diffuse envelope (Mark.9), or without it (Mark.305, Kaz.102). It is interesting to note that Mark.9 and Kaz.102 are Sy 1 galaxies, but Mark.305 has no emission lines at all.

b) These galaxies are in general spirals. There are many Sy galaxies among them (Mark.10), but Kaz.73, for example, has comparatively narrow emission lines and also absorption lines.

c) This very interesting group of galaxies was studied in detail by Khachikian et al. (1978, 1979, 1981). The nuclei of these galaxies have a common diffuse envelope. There is no doubt that both nuclei have originated together and are physically connected.

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 encountered among double nuclei galaxies (Mark.266, 463, 673, 739, 789) (Khachikian, Petrosian and Sahakian 1978b, 1980a). It is very significant that among them there are galaxies in which both nuclei show Seyfert-type spectra. In Table 1 the apparent and absolute photographic magnitudes (rough estimation) of the components of the nucleus, distances between components in arcseconds and kpc, and radial velocity differences are presented (H = 75 km/sMpc) for some galaxies with double nuclei:

Table 1. Parameters of 6 representative UV galaxies with double nuclei

Mark. No.	m_{pg}	M_{pg}	d "	d kpc	V_r km/s
266	17.5 17.8	-17.8 -17.5	12	6.5	127
273	17.5 18.2	-18.4 -17.7	4.3	3.2	-
463	17.0 17.2	-19.5 -19.3	4.5	4.3	50
673	16.2 16.2	-19.6 -19.6	5.3	3.7	166
739	16.2 17.0	-19.1 -18.3	6.6	3.8	85
789	16.0	-19.5	4.1	2.5	2

The existence of galaxies with two condensations in the centre having Seyfert-type spectra (Mark.266, 463, 673, 789) is the most definite evidence of the possibility of galaxies with double nuclei in general. However, double nuclei galaxies are not an unusual phenomenon among active galaxies while they are particularly common among UV galaxies.

https://doi.org/10.1017/S0074180900154920 Published online by Cambridge University Press

I would like to remind you once more of the double Seyfert nuclei galaxy Mark.266 (Khachikian 1979) and show its isodensities and spectrum obtained with the 6m telescope of SAO of AS of the USSR (fig.7a). I do this because quite recently (and more than five years after our paper) Keel (1985) found the same phenomenon in the nucleus of the Seyfert galaxy NGC 5929 (unfortunately, he didn't quote our paper). The difference is that in Mark.266 we found that the two nuclei rotate in opposite directions while in NGC 5929 it is not apparent.

The interesting spectrum of Mark.496 near the Hα line is also shown in fig.7b. In this case both nuclei show a strong rotation. The masses of the components are: $M_1 \sim 8{\times}10^8\ M_{\odot}$, $M_2 \sim 2{\times}10^9\ M_{\odot}$.

d) A good example of this group is Mark.273 (fig.4). Recently, on the basis of the observations with the 2.6m telescope of the Byurakan Observatory and with the 6m telescope of the SAO morphological and spectroscopic investigations of four galaxies of this type, Mark.423, 739, 773 and 984 have been carried out by Khachikian et al. (1985). Some approximate data about these galaxies are presented in Table 2 (fig.7).

Table 2. Parameters of 4 representative UV galaxies with jets

Mark. No.		m_{pg}	M_{pg}	Sizes Sec. of arc	Sizes kpc
423	(integral)	14.9	-20.6	42 × 24	26 × 15
	nucleus			3.0	1.9
	jet			7.6 × 2.6	4.7 × 1.6
739	(integral)	14.8	-20.6	30 × 27	16.9 × 15.2
	E-nucleus	17.0	-18.4	5.3	3.0
	W-nucleus	16.2	-19.2	4.1	2.3
	jet			11 × 4.5	6.2 × 2.5
773	(integral)	14.1	-16.2	30 × 24	1.7 × 1.3
	SE-nucleus	17.5	-12.8	5.7	0.32
	SE-jet			7 × 4	0.4 × 0.2
	its knot	16.0	-14.3	4.3	0.2
	NW-nucleus	17.5	-12.8	6.2	0.35
	NW-jet			23 × 2.2	1.3 × 0.1
	its knot	18.5	-11.8	3.4	0.2
984	(integral)	15.1	-21.9	84 × 48	80 × 46
	nucleus	17.0	-20.0	3.2	3
	jet			15.6 × 3	14.8 × 2.8
	I knot	18.5	-18.5	3.2	3.0
	II knot	19.5	-17.5	3.0	2.8

Mark.423 is a Seyfert 2 galaxy (Afanas'ev et al. 1980) with the morphological type Sa (Osterbrock 1981). The jet begins to be visible at a distance about 4" from the nucleus (~ 2.5 kpc).

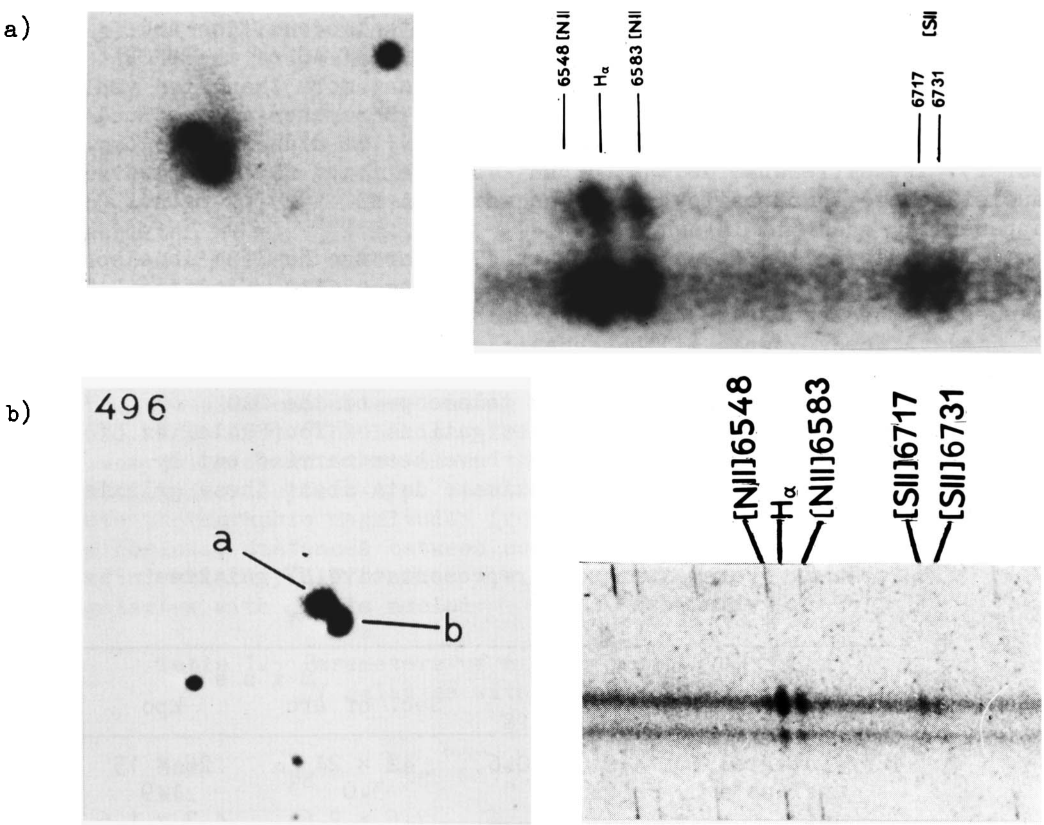


Fig. 7. Double nuclei galaxies
a) Mark.266 (1 mm ~ 1".8) and its spectrum;
b) Mark.496 (1 mm ~ 1".7) and its spectrum

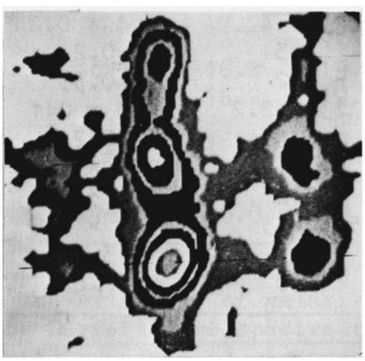


Fig. 8. Two-dimension Hα scan of three SA in Mark.297

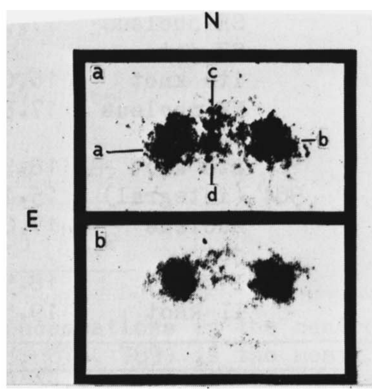


Fig. 9. Photos of the "twin" objects near Mark.261 and Mark.262
a) in blue; b) in red; (1 mm ~ 0".5)

Mark.739 is a double nucleus galaxy: the E nucleus has very strong Sy 1 properties, the W one is a superassociation (Khachikian et al. 1979b). The jet starts in the region between the nuclei.
Mark.773 looks like a double-nucleus galaxy. Almost perpendicular to the line joining the nuclei, in two mutually opposite directions from the centre two jets come out. The SW is short and ends with a starlike knot. The NE jet is longer and also has a knot just in the middle of it. Both nucleus and knot in the SW jet show emission-line spectra.
Mark.984 = Arp 119 is a destroyed spiral galaxy, from the nucleus of which to the north in the direction of the neighbour SO galaxy the jet with two knots goes out. The distance from the nucleus to the first knot is about 6".2 (5.9 kpc), and to the second one 13".6 or 12.9 kpc. According to Afanas'ev et al. (1980) Mark.984 is a Sy 2 galaxy. In the spectrum of the first knot the emission lines [SII], [NII], Hα, [OIII], Hβ, Hγ and [OII] are visible. FWHI is equal to 1000±90 km/s. In the spectrum of the second knot the emission lines [NII], N_1, Hβ, Hγ and [OII] are visible; Hα is very weak. FWHI of emission lines is equal to 300±115 km/s.

Very few spiral galaxies with jets are known - maybe only NGC 1097 (Arp 1976) and UGC 3995 (Keel 1985). We found two more: Mark.423 and 984. It is interesting to note that knots in jets have different physical properties: the knots in M87 have continuum spectra only, while in NGC 3561, IC 1182 (Stockton 1972) and 3C 277.3 (Breughel 1981) the spectra of knots look like the spectra of superassociations.

The majority of galaxies with jets are Seyferts of high luminosity. Mark.773 is an exception. None of the jet galaxies is a strong radio source.

e) There are quite a number of objects of this type among UV galaxies. They have no quite definite morphological structure or nucleus: their central parts consist entirely of a number of compact condensations of spherical form or sometimes a little elongated. Usually they are involved in a common envelope. The most important is that it is difficult to distinguish one of them as a central body of the system either by physical and dynamical properties or by geometrical location. For this reason we often refer to these objects as galaxies with splitting nucleus. All these components of the nuclear parts of galaxies have emission spectra like the spectra of Superassociations (SA). In other words these objects mostly consist of SA.

Because of the absence of Dr. J. Heidman, who was going to give us a paper about this type of galaxy, "clumpy galaxies", I would like to say some words about them. Dr. Heidmann with collaborators investigated many objects of this type (Heidmann 1985). The classical examples of this type of objects are Markarian 7, 8, 35, 325, Kazarian 5 (NGC 6306) (Khachikian 1972; Kazarian and Khachikian 1977; Khachikian 1984; Burenkov and Khachikian 1986). It is clear now that all knots of these galaxies show approximately the same spectra: emission lines of the Balmer series and forbidden lines [SII], [NII], [OI], [OII], [OIII], [NeIII]. The continuum spectra have different strengths. Sometimes the spectrum consists of strong emission lines only without continuum.

Because we have many contributed papers concerning SA, I am not going to discuss here these objects in detail. However, I would like to emphasize the problem of the dynamics of these objects. It seems to me that the investigation of their dynamics will give us a possibility for better understanding of the nature and evolution of these galaxies. There are not many works concerning this problem. Perhaps the first one was done by Burbidge and Burbidge (1968), concerning the dynamics of knots in the very peculiar galaxies NGC 4038-4039.

We studied in detail Mark.7 (Khachikian 1984), Mark.8 (Khachikian 1972) and Kaz.5 (Kazarian and Khachikian 1977). Their central regions contain five bright condensations each included in the diffuse envelope. All condensations have strong emission line spectra. The dynamics of these galaxies is very interesting. The knots of Mark.7 and 8 form two almost rectilinear segments in a figure resembling the letter "V" (Mark.8) and an upside-down letter "V" (Mark.7) respectively. In Mark.8 the segments show rotation around the point of crossing of two segments, so that the opposite ends of the segments move away from each other (at a velocity of about 170 km/s). In Mark.7 one segment (western) shows a solid body rotation with radial velocity difference of 180 km/s between the two ends, while the other (eastern) shows no appreciable rotation. However, it is very exciting that in both galaxies the points where the segments intersect have the same radial velocities, about 3000 km/s.

This fact speaks in favour of a common physical nature of both segments according to V. Ambartsumian's conception. In other words in Markarian 7 and 8 we have a single galaxy with a complex kinematical structure rather than a double system. We have found the same picture in Kazarian 5.

I would like to present here also a recent result concerning Mark.297 (NGC 6052). The spectra of Mark.297 have been obtained with the SAO 6m telescope by my graduate student A. Burenkov. This very interesting irregular galaxy consists of several (at least 10) knots, which have different sizes and brightnesses (see fig.1a in Burenkov's article). The sizes of knots range from about 500 pc up to 1200 pc. The seven brightest knots have in their spectra strong Balmer emission lines as well as N_1, N_2, and 3727 [OII] forbidden lines; [NII] and [SII] lines are also clearly visible. The velocity field over the whole galaxy is investigated with long-slit spectral observations at different position angles. The results are very exciting.

Relative to knot No. 1 which has V_r = 4700 km/s and may be located at the dynamical and geometrical centre of the galaxy, all eastern parts of Mark.297 have positive V_r, and all western have negative V_r (see fig.1c in Burenkov's article). Besides, the rotation of three central knots Nos. 1, 2 and 3 is clearly seen (fig.8). And what is more interesting is that knot No. 1 is rotating in the opposite direction in comparison with the neighbouring knot No. 2 (to the south-east) and No. 3 (to the north-west). It is well visible in fig.8 where two-dimensional scans of Hα and [NII] emission lines of these knots are presented. The PA of the slit was equal to 114°.

Assuming solid-body rotation the masses of these knots have been estimated (in solar mass) as $M_1 = 3\times10^9$, $M_2 = 3\times10^9$ and $M_3 = 2\times10^8$.

https://doi.org/10.1017/S0074180900154920 Published online by Cambridge University Press

The distance between knots is about 5" or 1500 pc. More about this galaxy is given in Burenkov's article in this volume.

It is important to draw your attention to the fact that objects like SA are very common among UV-galaxies. The majority of narrow emission line UV-objects actually turn out to be SA or have spectra which look very similar to the spectra of SA.

UV-galaxies can be divided into the following groups according to the location of SA in them and their morphology:

(i) objects which were included in early Markarian lists but in reality turned out to be SA in nearby galaxies (Mark.94, 59, 256).

(ii) UV-galaxies whose central regions consist of two condensations or knots approximately equal in brightness, one or both of which are SA (Mark.306, 739, 789). This group is just the same as the above morphological group c).

(iii) UV-galaxies with SA outside the nucleus (Mark.307, 319, 1118).

(iv) UV-galaxies whose central regions consist of several SA (Mark.7, 8, 35, 325, 297, Kaz.5). We have already discussed this group above, so we can conclude that all multinuclei or multicondensation galaxies consist of SA.

(v) UV-objects which are in reality isolated SA (Mark.116 = I Zw.18).

I would like to describe each of these groups separately.

(i) The explanation given above was first ascertained for the case of Markarian 94 (Arp and Khachikian 1974) and this question was then studied in detail by Khachikian and Sahakian (1975). It is not yet quite clear why these objects were selected as UV-galaxies; in fact, we have here not UV-galaxies, but just SA with UV excess. It is necessary to note that in the majority of these cases the host galaxies have irregular form.

(ii) Such cases occur rather often among UV-galaxies. This type of object has been studied by Khachikian, Petrosian and Sahakian (KPS 1978, 1979a, 1979b, 1980b, 1980c, 1983a; Khachikian et al. 1981).

For example, in Mark.212, 237, 306, 496, 673, 731, 789, 930 both components look spectroscopically like SA, but in Mark.739 one of the components is a SA, while the other is a Seyfert nucleus.

In Table 3 some data (Petrosian 1983) about nuclei of a number of this type of galaxy are collected: in the first two columns the distance between components and difference of radial velocities are presented. It is important to note that SAs can sometimes play the role of the nucleus of the galaxy with the same success as a normal or Seyfert one. The absolute magnitude of double nucleus components is found between -12m - -21m. The more these components are separated the brighter they are, and more structural details appear such as filaments, jets and spiral arms.

(iii) The large number of UV-galaxies contain different numbers of bright condensations, the majority of which turn out to be SA. In 56 spiral UV-galaxies from Markarian lists we found and studied about 150 SA (Khachikian et al. 1983b, 1984a, 1984b).

https://doi.org/10.1017/S0074180900154920 Published online by Cambridge University Press

Table 3. Parameters of UV galaxies with double SA nuclei

Mark. No.	R,kpc	ΔV_r	$M/10^{10}M_\odot$	$L/10^{10}L_\odot$	M/L ($M_\odot/L_\odot$)
104	0.8	20	0.027	0.14	0.2
111	2.0	97	1.6	0.70	2.3
121	5.8	194	19	0.60	31.7
212	5.2	250	28	1.3	21.5
237	1.8	300	14	2.5	5.6
306	2.2	54	0.55	1.0	0.6
463	5.5	50	1.2	2.5	0.5
480	3.1	49	0.63	1.3	0.5
496	3.5	151	6.8	2.2	3.1
673	3.7	166	8.7	3.3	2.6
710	1.0	48	0.20	0.056	3.6
712	1.4	31	0.11	0.90	0.1
721	2.5	50	0.53	2.5	0.2
731	0.4	20	0.014	0.09	0.2
739	3.8	86	2.4	1.4	1.7
786	0.4	60	0.12	0.03	4.0
788	8.8	72	3.9	1.9	2.1
789	2.5	2	0.0085	3.9	0.0002
799	4.1	28	0.27	0.27	1.0
930	1.8	0	0	0.99	0.0
1027	5.6	60	1.7	2.2	0.8

Statistical analyses show that:

- the mean linear size of SA is equal to about 1 kpc, and the mean absolute magnitude is close to -15m;
- SA appear among dwarf, giant and supergiant galaxies. In many cases they appear in SB galaxies, mainly in the spiral arms and at the edges of the bars;
- in the distribution of distances of SA from the nucleus a strong maximum appears near 0.4 R_{gal} and a weak one near 0.8 R_{gal};
- about 10% of UV-galaxies with SA are Seyfert galaxies and more than 10% are multinuclear galaxies. Among them more than 30% are radio sources (S_ν > 10 mJy).

(v) These remarkable, very compact, sometimes starlike objects consist mainly of high luminosity hot stars and gas. Searle and Sargent (1972) were the first who paid attention to these objects. Kunth and Sargent (1983, 1985) carried out a more detailed study of such objects.

All galaxies of this group have bright emission spectra with the following characteristic peculiarities:

1) high degree of excitation;

2) [OIII] line intensity is 5-10 times as bright as Hβ but [OII] 3727 and [NII] lines are weak. The absolute brightness of these

https://doi.org/10.1017/S0074180900154920 Published online by Cambridge University Press

objects ranges from $-13^{m}.9$ to $-19^{m}.0$. It has been found that there is 3.5-20 times oxygen deficiency.

The prototypes of this group were II Zw 40 and I Zw 18, which is also Mark.116. It is interesting to note that each of these objects in reality consists of two condensations. So the question still arises of whether these objects are isolated or show a double feature. From this point of view I would like to call once more your atention to the "twin" objects near Mark.261 and 262 (Arp et al. 1974; Khachikian 1976).

These blue objects are located at a distance of about 2' to the north of Markarian 261 and 262. In blue light they appear in the form of two compact condensations joined together by means of two bars (fig.9). In red light the bars become barely visible. The distance between the "twin" objects is about 4 kpc in projection. Both objects have very strong emission line spectra.

A notable peculiarity of this system is the great similarity of the components; their shapes, dimensions, radial velocities, luminosities and spectra are nearly identical. Because of their faintness (m_{pg} = 18.5) they have not been included in the first Byurakan Spectral Survey, but I am sure they will be in the second one.

On the one hand, the "twin" objects are a double nucleus galaxy without any stellar environment or common diffuse envelope; on the other hand, there are pairs of isolated SA's. Actually, we have here the origination of two particular galaxies, consisting of hot stars and surrounding gas envelope only. Recently Shaver and Chen (1985) published data on four objects of this type discovered on objective prism plates taken with UKST. I would like to note in particular that all these four objects are also double. This confirms our above opinion that very likely most isolated HII giant regions are double. Dr. D. Alloin will speak in detail about these objects.

CONCLUSION

To conclude, I would like, once again, to emphasize the fact that although the galaxies considered above differ both in their morphological characteristics and in the form of activity, the presence of UV-excess is a trait common to all. But this is the only similarity they have.

Among UV-galaxies there are quite different objects with different degrees of activity, which can be classified spectroscopically in six quite different groups and which morphologically span all possible types ranging from all Hubble types to Zwicky galaxies, Haro objects, BL Lacs and so on.

Today the large-scale detailed study of morphology and dynamics of central parts of UV-galaxies acquires great significance.

Observational data confirm that the central parts play the basic role in the activity of UV-galaxies. Thus, relying on an analysis of the morphological and spectroscopic data of galaxies with UV-excess alone, it is evident that most of them manifest themselves as galaxies with one form of activity or another according to Ambartsumian.

REFERENCES

Adams, T.F.: 1977, Astrophys. J. Suppl., **33**, 19.

Afanas'ev, V.L., Lipovetsky, V.A., Markarian, B.E., Stepanian, J.A.: 1980, Astrofisika, **16**, 193.

Ambartsumian, V.A.: 1956, Izvestija AS of Armenia, Ser. Physics Mathematics, **9**, 23.

Ambartsumian, V.A., Shahbazian, R.K.: 1957, Dokladi of AS of Armenia, **25**, 185.

Ambartsumian, V.A.: 1958, La Structure et Evolution de L'Universe, p.241, Solvey Conference, Ed. R. Stoops, Brussels.

Ambartsumian, V.A.: 1958, Dokladi AS of Armenia, **26**, 277.

Ambartsumian, V.A.: 1962, Trans. IAU XIB, p.145, Academic Press, London-New York.

Arp, H.C., Heidmann, J., Khachikian, E.Ye.: 1974, Astrofisika, **10**, 17.

Arp, H.C., Khachikian, E.Ye.: 1974, Astrofisika, **10**, 173.

Arp, H.C.: 1976, Astrophys. J., **207**, L147.

Barbieri, C., Bonoli, C., Rafanelli, P.: 1979, Astr. J. Ap. Suppl., **37**, 541.

Brecher, K.: 1976, Frontiers of Astrophysics, Harvard Univ. Press, Ed. E. Avrett.

Breughel, W. van: 1981, Optical Jets in Galaxies, ESA, Sp.-162, 49.

Burbidge, E.M., Burbidge, G.R.: 1968, IAU Symposium No. 29, Yerevan, p.415.

Burenkov, A.N., Khachikian, E.Ye.: 1986, Astrofisika, **24**, 349.

Haro, G.: 1956, Bol. Obs. Tonantzintla y Tacubaya, **14**, 8.

Kazarian, M.A., Khachikian, E.Ye.: 1977, Astrofisika, **13**, 415.

Keel, W.C.: 1985, Nature, **318**, 43.

Keel, W.C.: 1985, A.J., **90**, 2207.

Khachikian, E.Ye.: 1968, A.J., **73**, 891.

Khachikian, E.Ye.: 1972, Astrofisika, **8**, 529.

Khachikian, E.Ye.: 1972, IAU Symposium No. 44, Uppsala, p.160, Reidel Publ.

Khachikian, E.Ye.: 1976, Astronom. Nachricht., **297**, 287.

Khachikian, E.Ye.: 1979, Star and Star System (ed. B. Westerlund), 107, Reidel Publ. Co.

Khachikian, E.Ye.: 1983, Highlights of Astronomy, vol. **6**, 459, (ed. R. West).

Khachikian, E.Ye.: 1984, Astronomy with Schmidt-type telescope, 427 (ed. M. Capaccioli), D. Reidel.

Khachikian, E.Ye., Korovyakovsky, Yu.P., Petrosian, A.R., Sahakian, K.A.: 1981, Astrofisika, **17**, 231.

Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1978, Astrofisika, **14**, 69.

Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1979, Astrofisika, **15**, 209.

Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1979b, Astrofisika, **15**, 373.

Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1980a, Astrofisika, **16**, 621.

Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1980b, Astronom. Letters (USSR) **6**, 262, 552.
Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1980c, Astrofisika, **16**, 589.
Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1983a, Astrofisika, **19**, 171.
Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1983b, Astrofisika, **19**, 619.
Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1984a, Astrofisika, **20**, 51.
Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1984b, Astrofisika, **21**, 57.
Khachikian, E.Ye., Petrosian, A.R., Sahakian, K.A.: 1985, Astrofisika, **22**, 229.
Khachikian, E.Ye., Sahakian, K.A.: 1975, Astrofisika, **11**, 207.
Khachikian, E.Ye., Weedman, D.W.: 1968, Astrofisika, 4, 587.
Khachikian, E.Ye., Weedman, D.W.: 1971, Astrofisika, **7**, 389.
Komberg, B.V.: 1976, The Origin and Evolution of Stars and Galaxies, Publ. "Nauka", Moscow.
Kunth, D., Sargent, W.L.W.: 1983, Astrophys. J., **273**, 81.
Kunth, D., Sargent, W.L.W.: 1985, Prepublication No.107, Institut d'Astrophysique de Paris.
Osterbrock, D.E.: 1981, Astrophys. J., **249**, 462.
Petrosian, A.R.: 1983, Astron. J. Letters (USSR), **9**, 339.
Sargent, W.L.W.: 1970, Astrophys. J., **159**, 765.
Searle, L., Sargent, W.L.W.: 1972, Astrophys. J., **173**, 25.
Shaver, P.A., Chen, J.-S.: 1985, Astron. Astrophys., **148**, 443.
Stockton, A.: 1968, Astron. J., **73**, 887.
Stockton, A.: 1972, Astrophys. J., **173**, 247.
Vorontsov-Veliaminov, B.V.: 1972, Vnegalakticheskaya Astronomia, Publ. "Nauka", Moscow.
Weedman, D.W., Khachikian, E.Ye.: 1969, Astrofisika, 5, 113.

DISCUSSION

PISMIS: You showed us some Markarian galaxies with condensations close together. That configuration reminds one of the hot spots at the nuclei of some galaxies. Do we know the linear projected size of these assemblies of condensations? Are they significantly different from the hot spot nuclei of galaxies of which the outer region may be too faint to be observed?

KHACHIKIAN: The condensations I showed and hot spot in reality are the same type of physical objects - superassociations (or giant HII regions). The typical (photometrical) size of superassociations is around 2kpc. They have fairly good shapes and the error of the size is about 10-15%.