THE FIRST BYURAKAN SURVEY (FBS) AND SEARCH PROBLEMS FOR A G N

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ABSTRACT. The history of the First Byurakan Survey carried out to search for AGN is shortly described.The sample completeness for different classes of objects:Sy1, Sy2, QSO, BL Lac objects is estimated as 0.6, 0.4, 0.4 and 0.6,respectively. The lack of radioquiet BL Lac objects as a whole class is shown. Different search procedures of AGN are compared, their perspectives are evaluated.

1. SURVEY HISTORY.

In 1963 B.E.Markarian published his important paper concerning 41 peculiar galaxies. He drew a conclusion that "...in some of their nuclei there is non-stellar radiation". This sample contains all 8 galaxies marked by K.Seyfert in 1943. After installation of 1 meter Schmidt telescope with an 1:3 objective prism at Byurakan Observatory Markarian began his search for new galaxies with similar features.

All spectra have been obtained at a low dispersion of 1800 A/mm near $H\gamma$ line. The emulsion Kodak-IIAF was used as main one. As a main search criteria he used an excess UV-continuum in the galaxy spectrum for the given morphological type. Among them a great number of Seyfert galaxies were found. This extensive program when being fulfilled got the name - The First Byurakan Survey (FBS).

The Survey included the search for galaxies with UV-continuum and obtaining the slit spectra for detected objects. Table 1 presents main stages of this Survey.

E. Ye. Khachikian et al. (eds.), Observational Evidence of Activity in Galaxies, 17–23.

Table 1 First Survey Chronology

years	stage	observers
1964	First probe plates of the Survey on 1-m Schmidt telescope	Markarian
1966	presentation of the first list of 70 galaxies at IAU Symposium No.29	Markarian
1968	obtaining the first slit spectra USA	Weedman, Khachikian
1969	beginning of the northern sky Survey obtaining of first slit spectra in USSR	Markarian, Lipovetsky, Arakelian, Dibaj, Esipov
1975	Survey extension up to its south boundaries first probe plate on Kodak-IIIAJ	Markarian, Lipovetsky, Stepanian (MLS)
1977	first spectra on the 6m telescope	Afanas'ev, Lipovetsky, Shapovalova
1978	completion of Survey on1-meter Schmidt	MLS
	beginning of deep Survey (SBS) on Kodak-IIIAJ	MLS
1980	completion of the search for Markarian objects	MLS
1985	completion of spectral observation of objects from FBS	Afanas'ev, Erastova, Lipovetsky, Markarian, Stepanian, Shapovalova

FBS contains 1133 fields of 4^{o}x 4^{o} in size and covers a large area of the northern sky in high galactic latitudes that is equal to 17000 sq.degr.(5.2 sterad.).The south boundary of Survey in declination is -15° ($b < 0^{\circ}$) and -11° ($b > 0^{\circ}$). 1532 objects with the excess of UV-continuum were detected during this Survey, 43 of them being stellar objects (QSO candidates). Some thousands faint blue stars were also fcund which were not included into 15 lists of Markarian objects published in the "Astrofizika".

The objects fainter than 13.0 mag. were systematically included in the Survey, but its limiting magnitude is 17.0-17.5 mag. For the brighter than 15.5 mag. the Survey completeness is 0.5. All the Markarian galaxies can be roughly divided into two categories:objects with narrow emission lines and AGN. Further we shall deal with the last one.

2. AGN AND SURVEY COMPLETENESS.

Now 196 Markarian objects belong to AGN of different types: Sy, QSO, BL Lac objects, that is 13%. Up to now FBS is one of the most effective surveys for search of Seyfert galaxies. Let us evaluate the detection completeness of AGN of different types in FBS. The best estimation one can get by comparing with other samples. For Sy galaxies we can use the following samples with the spectral data:

1) the Survey of Center for Astrophysics - CFA (Huchra et al.,1983);
2) the Catalogue of Isolated Galaxy Pairs - CIPG (Karachentsev,1972);
3) the Galaxies of High Surface Brightness - GHSB (Arakelian, 1975).

Table 2 presents the characteristics of these samples,number of Sy1 and Sy2 galaxies (N) and also relative number of Markarian galaxies (D) among them,respectively.

Table 2 Seyfert galaxies in different samples

galaxies sample	limiting magnitude	sample value	N Sy 1	N Sy2	D Sy1	D Sy2
CFA	14.5	2401	18	25	0.67	0.44
CIPG	15.7	1202	9	16	0.56	0.50
GHSB	15.7	591	4	8	0.75	0.13
				mean:	0.65	0.40

QSO samples of both Byurakan Surveys were studied by Markarian et al.(1986).Here are some data.A sample obtained by Schmidt and Green (1983) in Bright Qusar Survey (BQS)is useful for near QSO. Due to the fact that only a few stellar objects (QSO candidates) were included into our survey we can compare the nearest QSO with faint envelopes.

The QSO were selected for BQS according to the following criteria: $m_{pg} = -23^m$ (H = 50 km/s/Mpc),U-B $<= -0.4$, $m_B = 16^m.2$ and Sy1 type spectrum.For the distance $z < 0.16$, 19 objects from FBS (28 in all) and 24 from BQS (92 in all) agree with these criteria. 9 objects are common for both surveys.If suppose that detection probability of nearby QSO is comparable in both Surveys then the full number of this type objects is near 50 and the completeness of FBS and BQS is 0.4 and 0.5, respectively. BQS completeness is considerably lower than 0.9 which was obtained by Schmidt and Green (1983). This effect should be taken into account when studying luminosity function of quasar evolu-

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tion. Quasars distribution of the both Surveys according to z is shown in Fig.1, where the data of all bright QSO ($m_B < 16^m.2$) not included into BQS are given. The data are taken from QSO catalogue (Veron-Cetty and Veron, 1985).

The next extremely interesting type of AGN are BLLac objects. Three well-known BL Lac objects were detected in FBS: Mark.421, 501 and 180. Among 10 brightest and nearest BL Lac ($m_B < 16^m.5$, $z < 0.10$) 5 ones are in our survey region, so their detectability is the same as for Sy1 galaxies.

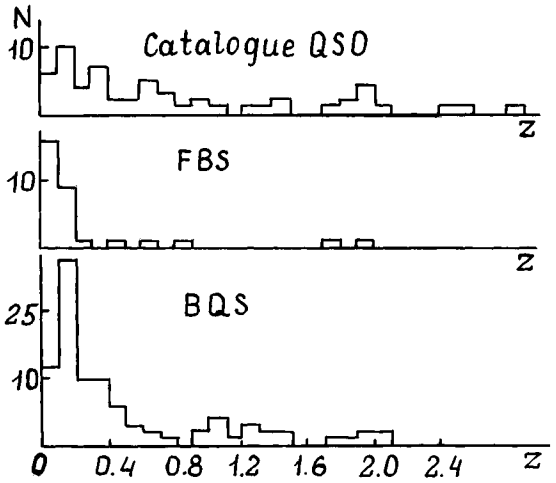

Figure 1. QSO redshifts distribution from FBS, BQS and of missing in BQS selected from QSO catalogue (Veron-Cetti and Veron, 1985).

Owing to the fact that intensive UV-continuum was the main search criterion, we could verify the hypothesis on existence of numerous class of radioquiet BL Lac objects. As in quasars we could expect that among BL Lac objects only 3-5% are radiosources. The radioquiet BL Lac objects ought to be the galaxies (apparently elliptical) with bright stellar-like nuclei and featureless spectra without any lines. Number of such objects could amount many dozens or hundred.

We carried out spectral observations with the 6 meter telescope BTA of all 150 Markarian galaxies in whose spectra emission lines were not detected earlier. None of new galaxies with featureless nucleus spectrum was found. The spectra of BL Lac objects on our searching plates do not differ from Sy1 galaxies so all selection effects influence equally the both types. The lack of similar objects on FBS means that either the radioquiet BL Lac objects do not

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exist or their number is not large. So, they can't significantly increase the spatial density of usual BL Lac objects.

From our estimations their spatial density is lower than in Sy1 by 30 times and is equal to $10^{-6.5}$ Mpc^{-3}. Indirectly these facts favour the model of BL Lac objects by Blandford-Rees -radio sources with a relativistic jet, emitting close to a observer's direction.

3. SEARCHING TECHNIQUE DEVELOPMENT.

The last catalogue of AGN (Veron-Cetti and Veron,1985) contains more than 600 Sy galaxies and nearly 3000 QSO. However their statistical study is difficult because of their extremely inhomogeneous samples. Except other ranges (R, X, IR) there are dozens of different surveys on optics which are devoted to search for AGN. All the optical searching methods can be divided into 3 groups:

a) morphological (search for compact galaxies,the galaxies of high surface brightness,interaction ones etc.);
b) colorimetric (search for blue galaxies Haro,blue stars TON, PHL, LB etc);
c) spectral (Byurakan Surveys,CTIO, UM, Case,surveys with grisms at 3.6-meter,4-meter telescopes,etc).

It is obvious that the last group is the most informative.So, the method suggested by Markarian has found a broad application all over the world. In many cases the presence of emission lines was used as a main search criterion. In spite of the great progress in detecting the new, distant QSO, this criterion leads to strong selection which can not be practically taken into consideration.

So, in the Second Byurakan Survey (Stepanian et al., 1986) we use as in old days the strong UV-continuum and the energy distribution in the spectrum as the main criterion.

The method suggested by Markarian 20 years ago proved to be the most effective and rather free from strong selections.Really, in our First Survey all the available information was used, that is:

- brightness concentration to the centre(morphological);
- object colour on the Palomar Sky Survey(colorimetric);
- energy distribution in the spectrum (spectral).

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A great attention was given to the last one. And really, this method combined all the aforementioned characteristics. The only one shortcoming of this method was a subjective visual evaluation of all the characteristics by the observer. A really great progress in this field was achieved at the end of seventies when automatical image processing systems were used at different observatories (Clowes et al, 1984; Lorenz,1986).

In order to avoid different factors of selection arising at both manual and automatic processing it is desirable to study the spectra of all objects.Such method was elaborated in SAO AS USSR with the 6-meter telescope and was named as "Multislit Field Spectroscopy" (Afanas'ev et al., 1986). Using this method we hope to obtain a sample free from numerous selections.

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DISCUSSION

OSTERBROCK: I have observed many of the Markarian galaxies from the First Byurakan Spectral Survey. As everyone knows, it is a very good list. Can you tell us if all the galaxies in those lists were picked out by one person - the late Dr. Markarian - or if some were picked out by him and others by the co-authors of the various papers?

LIPOVETSKY: I-III lists were made by Markarian alone. IV-IX lists were prepared in cooperation with Lipovetsky and X-XV ones in cooperation with Lipovetsky and Stepanian. The classification of objects was made by all authors. I want to note that objects from different lists can be situated in the same sky region. So, any complete sample of Markarian objects must be done only through the complete survey.

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