AGN SURVEYS
ASP Conference Series, Vol. 284, 2002
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The Byurakan-*IRAS* Galaxy (*BIG*) Sample: The Redshift Survey

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Abstract. The Byurakan-IRAS Galaxy (BIG) sample (1967 galaxies) is based on optical identifications of IRAS PSC sources at $\delta > +61°$ and $|b| > 15°$ (FBS area). A redshift survey for brighter objects ($B < 18^m$) is being carried out with the Byurakan Observatory 2.6m, Special Observatory 6m, and Observatoire de Haute-Provence 1.93m telescopes. 213 objects have been observed, and redshifts in the range 0.008-0.173 have been measured. For this subsample, 15% of the objects are AGNs, and 15% are LIGs and ULIGs.

1. The *BIG* Sample

A program of optical identifications of all IRAS PSC (IRAS 1988) sources at high galactic latitudes was conducted in the Byurakan Observatory in 1995 (Mickaelian 1995). The First Byurakan Survey (FBS) (Markarian et al. 1989), served as the basis for this work. The area of the FBS with $+61° < \delta < +90°$ at galactic latitudes $|b| > 15°$ was included with a total surface area of 1487 deg^2. The identifications were made on the basis of the Digital Sky Survey (DSS) images, the First Byurakan Survey (FBS) low-dispersion spectra, and the IRAS infrared fluxes at 12μm, 25μm, 60μm and 100μm wavelengths. 1577 sources have been optically identified, with 1178 sources corresponding to galaxies. The BIG sample (Byurakan-IRAS Galaxies) was constructed of 1178 newly identified galaxies and 789 other IRAS galaxies in the same area, known before (Mickaelian 2001, Mickaelian et al. 2001). The sample contains compact galaxies, interacting pairs and groups, "mergers", radio and X-ray sources, etc. Study of the sample is important for a better understanding of star-formation, nuclear activity, interactions and connections between these phenomena. 350 newly identified galaxies were bright enough ($B < 18^m$) to undertake a quick redshift survey with the available 2-6 m size telescopes. This was one of the subtasks of the whole Byurakan-IRAS program.

2. Spectroscopic Follow-up and the Redshift Survey

Medium-dispersion spectroscopic follow-up observations for the BIG objects with $B < 18^m$ in 1997-2000 were aimed at obtaining their redshifts and their classifications (Mickaelian et al. 1998; 1999; Balayan et al. 2001). New AGNs, composite spectrum objects and high-luminosity IR galaxies have been discovered

too; study of starburst/AGN/interaction phenomena and their interrelationship also became possible for some objects, and subsamples of interesting objects have been defined for further detailed studies. The redshift survey is the first task. After these observations, the IR luminosity function will be constructed and the space distribution of BIG objects will be investigated.

The observations have been carried out with 3 telescopes: 1) the Byurakan Astrophysical Observatory (BAO, Armenia) 2.6m telescope with the ByuFOSC focal reducer and the TM 1060×514 CCD; 2) the Special Astrophysical Observatory (SAO, Russia) 6m telescope (in collaboration with A.N.Burenkov, S.N.Dodonov, V.L.Afanasiev and A.V.Moiseev) with the UAGS spectrograph and K 585×530 or TK 1024×1024 CCDs, and the Multi-Pupil Fibre Spectrograph (MPFS, Afanasiev et al. 1995) with the TK 1024×1024 CCD; 3) the Observatoire de Haute-Provence (OHP, France) 1.93m telescope (in collaboration with P.Véron and M.-P.Véron-Cetty) with the CARELEC spectrograph and TK 1024×1024 or EEV 2048×2048 CCDs.

Different spectral ranges have been observed with different equipment, from 3600 Åto 8000 Å. The dispersions are 1.8-5.8 Å/pix and spectral resolutions of 5-14 Å have been obtained. The S/N ratios vary in the range from 5:1 to 50:1, except for a few spectra. Study of the objects with different telescopes and observational methods is more efficient both for quick completion of the program and better quality of classifications. The most interesting cases of AGN containing interacting pairs are being studied by means of 2D spectroscopy with MPFS. The statistics of the observations of the BIG objects is given in Table 1: telescopes, equipment, number of IRAS sources with observed counterparts, number of observed BIG objects, number of spectra obtained.

Table 1. Statistics of Observations of the BIG Objects in 1997-2000

Telescope	Equipment	IRAS sources	BIG objects	Spectra
BAO 2.6m	ByuFOSC	45	56	75
SAO 6m	UAGS	48	64	84
SAO 6m	MPFS	39	43	96
OHP 1.93m	CARELEC	64	69	74
All observations		172*	213*	329

* Some objects have been observed several times with different telescopes

3. Results Obtained

In all, 213 galaxies associated with 172 IRAS sources have been observed spectroscopically (some sources have more than one association, and all components have been observed to check their nature and find out which of them is responsible for the IR). Spectral observations revealed new AGNs and high-

https://doi.org/10.1017/S0252921100030724 Published online by Cambridge University Press

luminosity infrared galaxies. Redshifts for all observed galaxies have been measured (z=0.008–0.173), the distances are 80–1041 Mpc, the absolute magnitudes are in the range -17.5^m– -23^m and the calculated infrared luminosity is in the range $3\times10^9 < L_{fir} < 7.5\times10^{12}$ (for H_0=50), including some 30 LIGs and two ULIGs already discovered (IRAS 07479+7832a and IRAS 10252+7013).

The objects have mostly emission-line spectra with strong Balmer lines (mainly Hα and Hβ in the observed range), [O III] 4959/5007, [N II] 6548/6584, and [S II] 6717/6731 lines. [O I] 6300/6363, [O II] 7320/7330, [Fe VII] 6087, He I 5876 emission lines and Na I 5890 absorption line are often present. The spectra were classified and activity types of the galaxies were determined on the basis of the emission line ratios, using well-known diagnostic diagrams (Veilleux & Osterbrock 1987). The types are as follows: Sy2 - 21 objects, LINER - 3, composite spectrum objects - 7, HII - 143, normal (absorption-line) galaxies - 15, unknown (mainly because of low S/N) - 24. There are also 6 AGN contained in interacting/merging systems, interesting for further studies. The normal absorption-line galaxies must be investigated also to understand the source of their excess IR radiation. Objects having a composite spectrum (two distinct emission nebulae, for instance an HII region and a Seyfert, being superimposed on the slit, Véron et al. 1997) should be observed with higher resolution (< 3 Å) to study the profile of the various emission lines and to identify the nature of the emission objects.

Morphology and the spectra obtained allow separating different interesting subsamples for further studies. They are important for understanding of certain processes taking place in galaxies. Evidence of activity, starburst and/or interactions in the same object allows the study of connections between these phenomena toward understanding what triggers intense starburst processes.

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