SEARCH FOR EMISSION LINE GALAXIES TOWARDS NEARBY VOIDS

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Abstract

We present the results of our search for emission line galaxies (ELG) towards nearby voids and the first conclusions concerning their large scale spatial distribution. In order to find emission-line galaxies we started a survey using the IIIa-J objective prism plates from the Hamburg QSO Survey. Follow-up spectroscopy was used to obtain long-slit spectra and thus accurate redshifts of the selected candidates. A sample of 205 objects was finally obtained, of which almost half are newly discovered objects. The first results indicate that there are a few very isolated ELG. Most of these are distributed along the rim of the voids.

1 Introduction

Galaxy redshift surveys carried out over the last decade have revealed a grand picture of the large-scale structure of the Universe with tremendous complexity: coherent structures of galaxies, as well as large empty regions surrounded by filaments and sheets of galaxies and clusters. This view is primarily based on high-luminosity giant galaxies, which are known to constitute the tip of an iceberg of mostly low-luminosity dwarf galaxies. The question therefore arises: are the giant galaxies fair tracers of the large-scale structure? From an observer's point of view, the emptiness of the voids may be a result of observational bias. The above-mentioned galaxy maps may reflect special observational selection effects in surface brightness, integral magnitude or diameter. As we already know from the Local Group of galaxies, dwarf galaxies can have very small diameters. Many of them also have low or very low surface brightness. These galaxies probably dominate the galaxy number in the Universe, but only very few (a few percent) are contained in the catalogues . They are difficult to detect on Schmidt plates even at the distance of nearby voids because of their small projected diameters. These objects are good candidates to fill up the voids. From the theoretical point of view, there has been the prediction (e.g. [3], [6]) that giants and dwarfs are spatially segregated, based on the concept of "biasing galaxy formation ".

Several studies of the spatial distribution of dwarf galaxies were carried out to test this prediction, though no definitive conclusion was drawn. While the studies concerning low-surface-brightness dwarfs ([2]; [13]; [4]; [11]; [1]; [12]) did not in general favor the models of biasing formation, the results of some objective-prism surveys ([15]; [9]; [17]; [16]; [10]; [18]; [14]) have suggested that star-forming galaxies have been found in voids. Recent work in this field (see [7], [8]) reveled that, while the central part of the voids remains free of galaxies, some of the dwarfs populate the outskirts of the voids, and from these dwarfs, most of them are emission-line galaxies (ELG). As there already have been some hints that such galaxies can provide a positive result to this unresolved question, we have started a project to search for ELG towards nearby voids.

2 Selection of candidates and follow-up observations

We used published cone diagrams to identify nearby ($v_R \leq 7500 km/s$) voids. Four void regions were selected according to the following criteria: diameter larger than 20 Mpc, completely empty of CfA galaxies, galactic latitude $b \geq 30^o$. The candidates were selected on the objective prism IIIa-J plates taken in the frame of the Hamburg Quasar Survey (HQS) ([5]). Automated search software was applied to the low resolution digitized data to select spectra with blue continua. We select candidates only in a certain interval of intensity, missing thus the bright objects, which are not needed for our study, but also some very faint objects, that lie very close to the detection limit of the plate. We estimate that we can miss 2 very faint objects per plate (0.07 objects/deg^2). The selected spectra are rescanned individually with high resolution and the final digitized spectra are visually inspected for emission lines. The objects are mainly selected based on the strong [OIII]λ5007 line, which appears as a distinctive peak near the green head of the objective prism spectra. Often the [OII]λ3727 can be identified too. Though our main selection criteria was the presence of emission features, we have also second priority candidates that were chosen because of their very blue continuum. Digitized direct plates were used to determine coordinates and also overlaps. The total area scanned was 1248 deg^2.

Most of the candidates were observed with the 2.2 m telescope at the German-Spanish Observatory in Calar Alto, Almeria (Spain). We used both the standard Cassegrain Spectrograph and the new focal reducer system. Some observations were made with the focal reducer system at the Calar Alto 3.5 m telescope. The resolution varies between 0.5 and 0.9 nm and covers at least the wavelength region from 420 to 820 nm. Typical exposure times are 10-15 minutes. For 75% of our sample we obtained direct images in R and B, using the focal reducer systems at the 2.2 m and the 3.5 m telescopes.

3 Results of Emission line galaxy search

We obtained a sample of 205 objects, of which 202 are emission-line objects and 3 are galaxies with absorption. From our sample of 205 objects, 96 (47%) are newly discovered objects, 53

(26%) are objects found already in the literature but with no available redshift (sometimes mentioned only as IRAS sources or only as galaxies) and 56 (27%) are objects with redshifts given already in the literature. We have observed all the objects with unknown redshift. From the objects with available redshifts, 6 were reobserved, in order to estimate our redshift errors.

The apparent magnitudes (derived from the Hamburg prism plates) of our sample range between $15.9 \leq B \leq 19.5$. It is customary to give a magnitude for which a survey is complete, but for our sample the incompleteness are also described in terms of color, line fluxes and equivalent widths of the emission lines. (A detailed description of the incompleteness will be given in a future paper.) Most of our objects seem to be HII galaxies, though some of the direct images indicate the presence of some further morphologies, like HII regions in normal galaxies and irregular dwarfs. There are also some galaxies with disturbed morphologies, that show signs of tidal interactions or mergers. We discovered 3 new QSOs (z=0.785, z=0.954, z=2.996) and 3 Syl galaxies (z=0.0146, z=0.0390, z=0.3447). Some of our spectra suggest

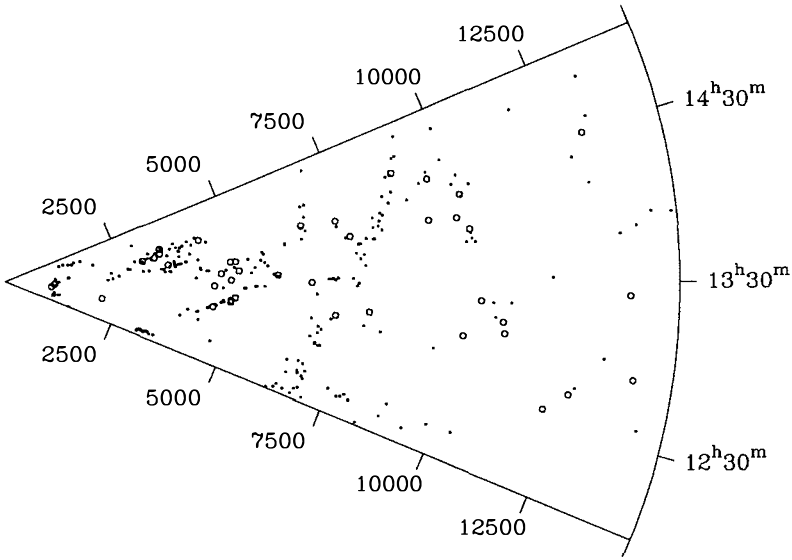

Figure 1: Cone diagram in velocity (km/s) and R.A. of one of our void region. The plot is for a strip of 7° in declination, centred on 36°30′. The small dots are CfA galaxies while the circles are ELG from our sample.

possible candidates for very low metallicity galaxies.

Our results are illustrated in a cone diagram of one of our void regions. We plotted in the same diagram our ELG (open circles), together with the CfA galaxies (small dots), as a comparison sample. There are obviously a few very isolated ELGs in our sample. These galaxies remain isolated also when we plot cone diagrams in declination. Most of the isolated galaxies are distributed along the rims of the voids. A detailed statistical analysis of the spatial distribution of our sample of ELG is in preparation. This analysis will clarify whether we found a more uniformly distributed galaxy population than that of giant galaxies and to which extent our galaxies spread into the voids. We will apply the nearest neighbourhood analysis as well as the two-point correlation function for this purpose.

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