A REDSHIFT SURVEY IN THE SOUTH GALACTIC POLE REGION

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ABSTRACT. We present preliminary results of a galaxy redshift survey we are accomplishing as an ESO Key Project over about 40 square degrees in a region near the South Galactic Pole, to a limiting magnitude $b_J = 19.4$. Up to now ~ 50% of the survey has been completed, providing about 2000 galaxy redshifts.

1. Introduction

In September 1991 we started a galaxy redshift survey over a strip 22° x 1.5° (plus a near-by area 5° x 1.5°, five degrees west of the strip) in the South Galactic Pole region. We plan to fill this area with a regular grid of circular fields with a diameter of 32 arcminutes (see Fig. 1). This size corresponds to the field of view of the multifibre spectrograph (OPTOPUS) we use at the ESO 3.6 m telescope.

The limiting magnitude of the survey is $b_J \leq 19.4$. We have selected the target objects from the Edinburgh Durham Southern Sky Galaxy Catalogue (Heydon-Dumbleton et al. 1988).

The total number of galaxies we plan to observe is of the order of 5000. Up to now we have obtained spectra for galaxies in 72 fields (shown as filled circles in Fig. 1) and have fully reduced data for 61 of them, obtaining 1726 galaxy redshifts.

At $z \simeq 0.12$, which corresponds to the peak of the selection function of the survey, the linear dimensions of the full strip are of the order of 120 x $8h$-1 Mpc.

The main goal of our project can be summarized as follows:

1) determination of the galaxy luminosity function (estimating both its shape and normalization) in a volume with dimensions large enough to average over the large scale inhomogeneities;
2) study of the statistics of emission line galaxies (liners, starburst and Seyfert galaxies) in a large, unbiased sample of galaxies observed spectroscopically in a homogeneous way;

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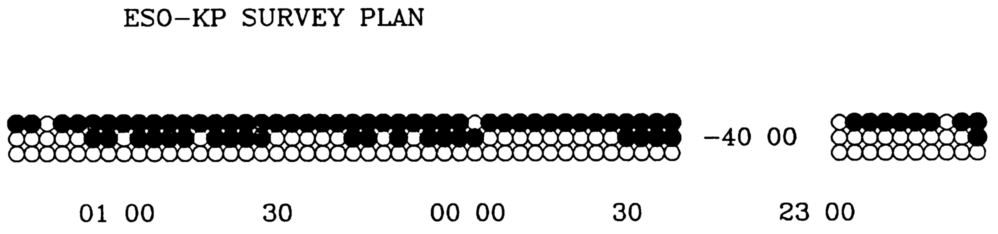

Figure 1. The survey plan. Each circle corresponds to an OPTOPUS field: the filled ones have been already observed.

3) measure of the size distribution of inhomogeneities in the galaxy distribution over a large volume.

In the next section we describe the observations and data reduction technique and in the last section we present some preliminary results.

2. Observations and Data Reduction

Observations have been obtained with the multifibre spectrograph OPTOPUS as the Cassegrain focus of the 3.6 m telescope at La Silla. OPTOPUS has 50 fibres which are manually plugged into holes drilled in aluminium plates. The diameter on the sky of the fibres is 2.4 arcseconds. At $b_J \leq 19.4$ the median number of galaxies per OPTOPUS field is 34. Four fibres are dedicated to the sky observations and the remaining 46 fibres are used to observe galaxies. When the number of galaxies in the field exceeds the number of available fibres, the galaxies to be observed are chosen at random from the galaxy list.

The spectra cover the wavelength range from 3730 Å to 6050 Å, with an effective resolution of about 3.5 Å. Spectra are flat-fielded, extracted and wavelength calibrated. Then the relative transmission of each fibre is computed by normalizing each spectrum through the flux of the OI $\lambda 5577$ and Na $\lambda 5891$ sky lines. After subtraction of the average sky, the redshifts are measured by cross-correlating the spectra with a set of template stars observed by us with the same instrument. Emission lines (when present) are also measured, as well as the equivalent width of the most common emission lines. The median error in velocity for the total sample is ~ 50 km/s. About 75% of the fields observed up to now have a redshift completeness greater than 60%.

3. Preliminary Results

The main scientific results so far obtained are summarized in the following paragraphs.

3.1 LARGE SCALE GALAXY DISTRIBUTION

The wedge diagram in Fig. 2 shows the distribution in distance of the galaxies measured so far. The galaxy distribution shows two outstanding structures at distances of ~ 180 Mpc and ~ 310 Mpc, crossing the diagram from side to side. Note also that this slice does not intercept any region devoid of galaxies (voids) with dimensions larger than $50h^{-1}$ Mpc. A quantitative analysis, however, will be possible only on completion of the survey.

3.2 LUMINOSITY FUNCTION

The well controlled selection of our sample and the relatively large number of redshifts already obtained allow us to estimate *for the first time* the shape parameters of the galaxy luminosity function at magnitudes as faint as $b_J = 19.4$, in a volume of space where large scale structure is averaged out and therefore this luminosity function really represents the 'universal' luminosity function at moderate redshift ($z \leq 0.2$).

Following Sandage et al. (1979), we have derived the parameters of the Schechter functional form of the luminosity function, through a maximum likelihood method. The best fit parameters are $\alpha = -1.10$ and $M_{bJ}^* = -19.67$.

3.3 EMISSION LINE GALAXIES

A surprisingly large fraction of galaxies (~ 40%) shows the presence of one or more emission lines (OII $\lambda3727$, $H\beta$, OIII $\lambda4959$ and $\lambda5007$). These objects can be either spiral galaxies, where lines originate mostly from HII regions in the disks, or early type galaxies undergoing a significant burst of star formation.

Figure 3a shows the luminosity function (with arbitrary normalization) obtained for our sample: the solid line corresponds to the Schechter functional form obtained through a parametric maximum likelihood, while the solid circles have been determined through a modified version of the non-parametric C-Method (Lynden-Bell 1971). The 68% and 95% confidence ellipses for α and M_{bJ}^* are shown in the inset, where the cross represents the best estimate obtained by Loveday et al. (1992), from their survey of galaxies with $b_J \leq 17.5$. The excellent agreement between our best fit parameters and those obtained by Loveday et al. (1992) shows that, up to a depth of $\simeq 600h^{-1}$ Mpc, the overall shape of the luminosity function is well described by a Shechter function with a faint-end slope $\alpha \sim -1.1$.

Figure 3b shows the 68% and 95% confidence ellipses for α and M_{bJ}^* for galaxies with and without detectable emission lines. The permitted contours are clearly separated at more than 2σ level: the galaxies with emission lines have steeper power law slopes and fainter M_{bJ}^*. This result is qualitatively consistent with the differences in the parameters of the luminosity functions of early and late type galaxies found by Loveday et al. (1992).

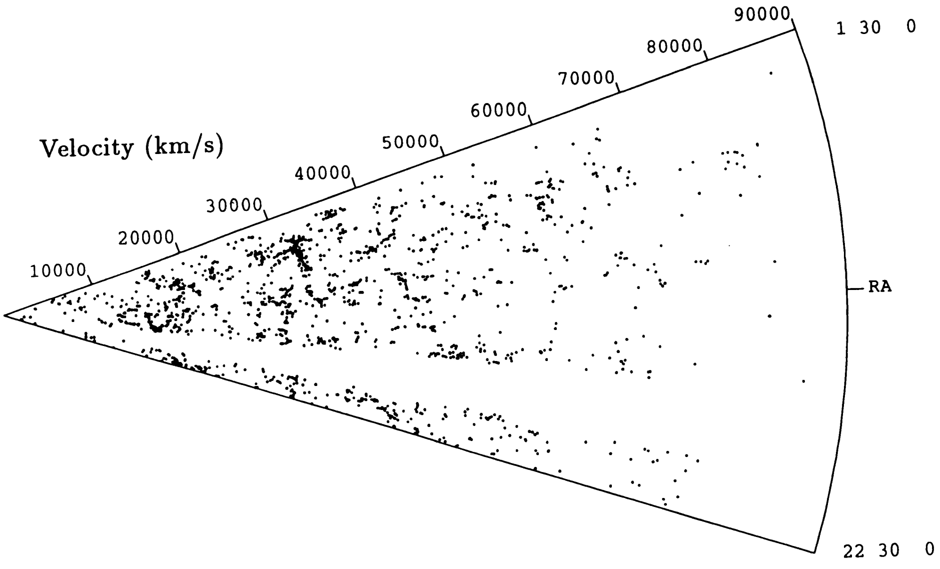

Figure 2. Wedge diagram, compressed in declination, for the 1700 galaxies so far measured.

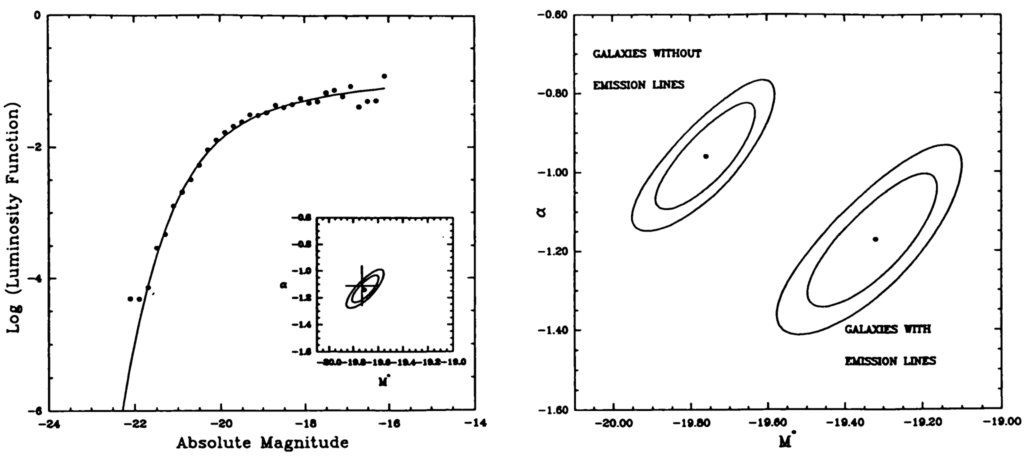

Figure 3. Galaxy luminosity function. b: 68% and 95% confidence ellipses for α and $M_{b_j}^*$ for galaxies with and without detectable emission lines.

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References

Heydon-Dumbleton, N.H., Collins, C.A. and MacGillivray, H.T., 1988. In 'Large-Scale Structures in the Universe', eds. W. Seitter, H.W. Duerbeck and M. Tacke, Springer-Verlag, p. 71.

Loveday, J., Peterson, B.A., Efstathiou, G. and Maddox, S.J., 1992. *Astrophys. J*, **390**, 338.

Lynden-Bell, D., 1971. *Mon. Not. R. astron. Soc.*, **155**, 95.

Sandage, A., Tamman, G. and Yahil, A., 1979. *Astrophys. J*, **232**, 252.