# THE LARGE-SCALE DISTRIBUTION OF GALAXIES IN THE SOUTHERN HEMISPHERE

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## ABSTRACT

Here we present a first hand look at the space distribution of some 2000 galaxies from a recently completed redshift survey in the southern hemisphere. This sample extends to the southern skies the database of high-quality radial velocities of the CfA Redshift Survey, over a comparable volume of space.

## I. INTRODUCTION

Over the past 5 years a considerable effort, involving several groups, has been made to conduct a wide-angle redshift survey of the southern skies. This Southern Sky Redshift Survey (SSRS) has been a collaborative effort between groups at the Observatório Nacional (in collaboration with the Harvard-Smithsonian Center for Astrophysics), Las Campanas Observatory and South African Astronomical Observatory. The sample is diameter-limited and contains 2028 galaxies from the ESO catalog (Lauberts 1982), down to major diameters of about 1.2' (see da Costa et al. 1987 for a more precise definition), in the region south of $\delta = -17.5^{o}$ and below galactic latitude $b = -30^{o}$. The observations were made using very similar detectors mounted on medium-size telescopes of the ON, LCO and SAAO. Very similar reduction techniques have also been employed, resulting in a rather homogeneous, high-quality, database. Cross-comparison of overlapping samples indicate that all sets have an accuracy of about 40 km/s and zero-point shifts within 20 km/s.

Our choice of working with a diameter-limited sample was due primarily to the lack of a correspondingly large photometric survey of the southern skies. In order to guarantee that we would probe a volume at least as deep as the 14.5 sample in the north we have adopted a diameter-cutoff which yields a mean surface number density of galaxies comparable to the original CfA survey. It turns out that in the south this selection criterion has led to a somewhat deeper sample due to the absence of a concentration of galaxies comparable to Virgo.



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## II. RESULTS

Eliminating those entries in the ESO catalog representing more than one galaxy and for which the individual members do not meet our diameter cut, our sample is reduced to about 1960 galaxies. We have radial velocities for about 1700 of those: the remaining galaxies are low surface-brightness objects, which are difficult to be measured optically. In figure 1 we present the two most interesting cone diagrams in the declination range $-30^{o}$ to $-50^{o}$.

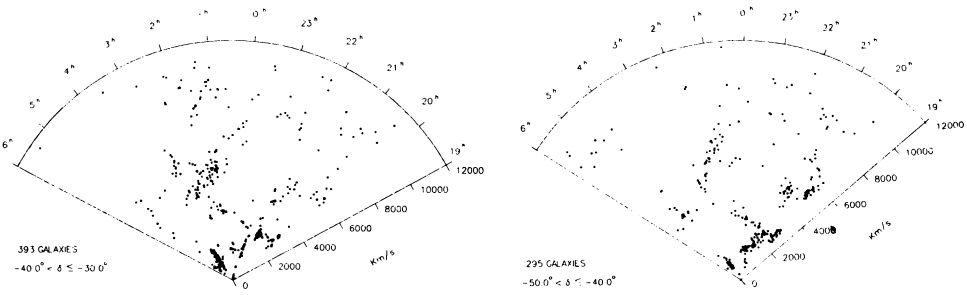


Figure 1. - Cone diagrams of right ascension versus redshift showing galaxies with V < 12000 km/s. The range in declination is indicated in the figures.

The following features are noteworthy. In contrast to the northern hemisphere, there are no prominent clusters in the south and only very mild virial distortions, associated with foreground clusters (Eridanus and Fornax), are present. This provides a somewhat clearer view of the large-scale structures, which in general cut across the line-of-sight. As in other previous surveys there seems to be a certain degree of coherence in the galaxy distribution over scales comparable to the survey depth. There is also a clear suggestion, by looking at successive wedges, that a large fraction of the galaxies tends to concentrate in sheet-like structures which divide the volume and appear to separate large empty regions. This can best be seen in figure 2 below where we plot part of the distribution of galaxies in a Cartesian coordinate system, in slabs $10h^{-1}$ Mpc thick ($H_0 = 100h$ km/s/Mpc).

In these figures there are at least two outstanding planar structures running across the surveyed volume, roughly parallel to each other. One of them is at a mean distance of $50h^{-1}$ Mpc; it extends to the limit of the survey area for at least $60h^{-1}$ Mpc in depth and $50h^{-1}$ Mpc across the observed declination range, with a thickness of 5 to $10h^{-1}$ Mpc. The second major structure to the west of the survey area is associated with the Telescopium-Pavo-Indus complex. It is apparently more fragmented than the first but maintains some degree of connectedness over as much as $60h^{-1}$ Mpc in the transverse direction, while limited by the western boundary of the survey. There is also a third lower density structure bridging these two and intersecting them at sharp angles.

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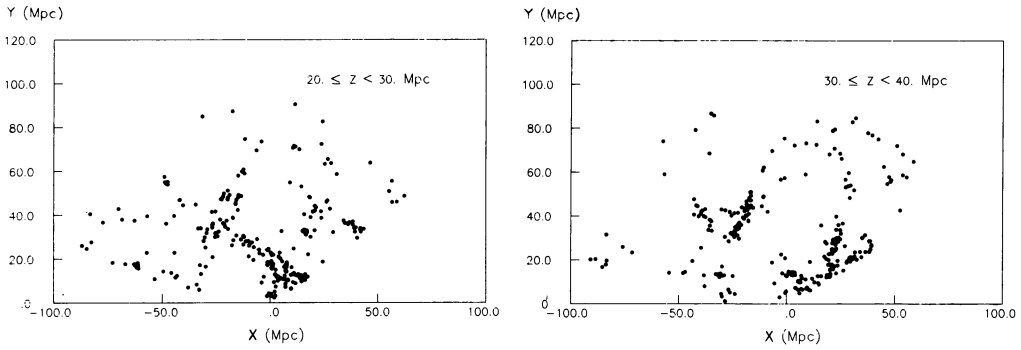


Figure 2. - Distribution of galaxies in an arbitrary Cartesian coordinate system. We show the projection onto the X-Y plane, of galaxies in the indicated Z range with V < 10000 km/s.

Another striking feature of the southern survey is the presence of at least three large empty regions, which are especially visible in the declination range $-30^{o}$ to $-40^{o}$. A preliminary analysis of the void distribution indicates that these voids extend to the borders of the survey and within it do not have well-defined shapes. Furthermore, at least two of them, to the east of the survey area, are probably connected. A lower-limit for the volume of the major voids is of $3 \times 10^{4}\ h^{-3}$ Mpc$^{3}$ corresponding to an equivalent radius of $20 h^{-1}$ Mpc. However this value could be even higher depending on the density contrast used to define voids. The major voids are relatively near, with mean distances of 6500 and 8000 km/s, and are interesting for future investigations of the empty regions.

Preliminary analyses of our sample, based on the two-point correlation function, show that the southern galaxy distribution has similar statistical properties as those derived for the northern sample, suggesting that we may already have a fair volume sample of the Universe at large. Quantitative results from the southern survey will be presented in forthcoming papers.

Finally, we should emphasize that several redshift survey programs in the southern hemisphere are still in progress such as the slice-survey of the declination zone between $-30^{o}$ to $-40^{o}$, wide-angle survey of the Hydra-Centaurus supercluster region and surveys of uncovered areas of the southern galactic cap ($b \leqq -30^{o}$). The rapid progress of the redshift surveys in the southern hemisphere vividly demonstrates the pressing need for a correspondingly large photometric survey of the southern skies. In addition, a serious attempt should be made to establish a common magnitude/diameter system to join the already available data in both regions of the sky in a homogeneous whole-sky catalog for statistical studies of the large-scale distribution of nearby galaxies.

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