SHAPE OF SUPERCLUSTERS

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ABSTRACT. Attempts to measure structural parameters of superclusters are described. Catalogues of superclusters have been prepared using a percolation algorithm applied to a complete sample of UGC galaxies brighter than the 14.5 magnitude. Both a two dimensinal (projected) and a three dimensional approach have been tried. The (conservative) result is that superclusters are certainly not spherical. Probably the departure from sphericity is towards elongated cigar-like structers. No evidence of relative alignements of superclusters has been found.

1. INTRODUCTION

In the last few years it has been established that visible matter in the Universe is distributed in large agglomerates of irregular form, the superclusters. Understanding their shape will strongly constraint the models of galaxy formation. The present contribution is an attempt towards the definition of some shape parameters of superclusters and the study of their statistical distribution.

2. THE PERCOLATION ALGORITHM

We have analyzed a sample which contains all the galaxies (3681) listed in the Uppsala Catalogue brighter than the 14.5 magnitude, selecting structures through a percolation algorithm.

This algorithm selects "friends of friends" and generates a system of sets. A set so selected is the ensamble of galaxies in which each member is separated from at least one other member by a distance smaller than a selected lenght R (percolation vector) and no other object of the sample is at such or smaller distance from any object of the set. Computing the percolation vector we take also into account the fact that in a magnitude limited sample the galaxy density is a decreasing function of distance, since, with increasing distance, only the more luminous galaxies enter the sample at encreasing distances. Furthermore we take into account the excess probability over a poissonian distribution of finding a galaxy at a distance R from another galaxy in agreement with the fact that the galaxy distribution is characterized by the two point correlation function.

Catalogues of structures have been obtained varying the percolation

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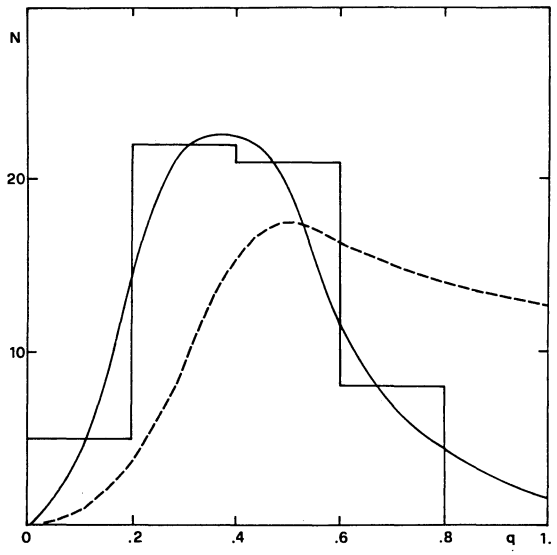

Figure 1. The flattening distribution of the structeres selected with R = 6 Mpc. The dashed line and the solid line show the fitting with a distribution of oblate or prolate spheroids respectively.

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vector R , and these structures have been analyzed in terms of shape parameters. Note that increasing R is equivalent to select structures at a lower density contrast above the mean.

2. SHAPE OF STRUCTURES

The underlaying assuption is that a supercluster can be idealized as a symmetric distribution of points: an ellipse or a three axis ellipsoid.

The flattening distribution of the structeres selected with a percolation vector of 6 Mpc, as they apper projected upon the plane of the sky, is given in Fig 1. The fittings by a distribution of oblate (dashed line) or prolate (solid line) spheroids, whose true axial ratio obeys a normal distribution, are also shown. The best fitting is clearly given by prolate ellipsoids (cigars), but simulations of a small number of points drawn at random from a sphere indicate that there is a tendency, when dealing with small statistics, to measure a prolate spheroid. Some structures are very elongated indeed. An example is a structure at RA 15 hours DEC +42 which has an axial ratio of 0.06.

In space structural parameters of superclusters have been defined by a weighted tensor which is defined in a similar way to the tensor of inertia of a set of points. Each point represents a galaxy in a structure (selected at a certain percolation vector) and the weights account for the density variations as a function of depth in a magnitude limited sample. The shape parameters are defined as the principal axes of the correspondent three-axis ellpsoid. Here again we have a tendency to have rather elongated structures , with a slight preference toward oblateness, but the presence of velocity dispersion, or peculiar velocities, tends to increase the depth of the structures and therefore would tend to transform a structure which looks like a string as projected on the sky into a disk or oblate form.

4. RELATIVE ORIENTATION OF CHAINS

Existence of relative alignements between large scale structures will give us clues on the coherence length of the physical phenomena which led to the supercluster formation.

We have searched for two possible kind of alignements: a) paralleleism of the major axis of a chain and that of the nearest chain, and b) orientation of the major axis of a structure in the direction of its nearest neighbor. Both tests gave a negative results.

5. CONCLUSION

The analysis shows the need of deeper samples in order to improve statistics, limitations of the approximation and above all the need of an approach more sensitive to the rather complicate topology of the Universe. For example a sponge like topology (see Gott, these proceedings) cannot be evidenced by our method.

The primary goal of our analysis, however, has been reached. That is that there is no strong evidence, within such a sample, of pancake-like structures.