THE DYNAMICS OF SUPERCLUSTERS

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Relatively little is known about superclusters. Observations of superclusters should increase our understanding of these grandest aggregates of matter and may tell us a great deal about the large scale distribution of matter in the Universe. We report here observations of two superclusters chosen from the list by Murray et al. (1978, Ap. J. [Letters], 219, L89).

We used the Shane 3-m telescope to obtain Image Tube Scanner (ITS) spectra of the three brightest central galaxies in each of the Abell cluster candidate members. The redshifts of the galaxies were measured by reducing the ITS spectra to linear intensity, plotting the linear intensity versus the logarithm of the wavelength, and then registering the plot against a high signal-to-noise ratio reference spectrum. The average internal standard error of the redshift is 120 k/s.

The mean radial velocities of the Abell clusters within 2° of the center of MFJG # 18 (1451 + 22 = ABELL # 11) show that the five clusters A1976, A1980, A1986, A1988, and A2001 form a tight group and thus are a supercluster. The remaining clusters A1997, A2008, A2009, and a cluster which projects behind A2001 are 30% or more distant than the five supercluster members.

The supercluster MFJG # 19 is similar to MFJG # 18. Five clusters (A2158, A2172, A2179, A2183, and A2196) form a tight group. The remaining four clusters (A2187, A2192, A2190, and A2198) are 36% or more distant than the supercluster.

We conclude that superclusters are real, but, because of projection effects, often may be less rich than their appearances.

The observed dispersions of the cluster velocities about the supercluster means are surprisingly small. The weighted means and weighted velocity dispersions are:

G.O. Abell and P. J. E. Peebles (eds.), Objects of High Redshift, 65–67.

Supercluster	$\bar{z}$	$\sigma_{\bar{z}}$ (k/s)	Avg. Std. Error per Cluster (k/s)
MFJG # 18	0.1166	363	364
MFJG # 19	0.1364	360	500

The observed dispersions include the uncertainty in the cluster means, and are consistent with true dispersions as small as 100 k/s to 200 k/s.

As a bench mark, we consider a simple model of an empty (pure Hubble flow) supercluster. Its angular diameter is 4°, the clusters are distributed randomly, but uniformly, throughout a cubical volume (ℓ^3), and the mean redshift is 0.12. The observed velocity dispersion is then:

$$\sigma_o = \frac{H_o \ell}{\sqrt{12}} = \frac{\Theta \cdot c(z + z^2/2)}{(1 + z)^2} = 600 \text{ k/s}.$$

Inclusion of the uncertainty in the cluster means gives σ_{obs} = 700 k/s to 800 k/s.

The data lead us to two alternative conclusions:

1. Superclusters are roughly spherical, deacceleration is important, and superclusters may be bound.

2. Superclusters are flattened systems, or "cell walls" as proposed by Jôeveer and Einasto (1978, The Large Scale Structure of the Universe, ed. Longair and Einasto), seen face on.

If the latter conclusion is correct, we must radically revise our view of the distribution of matter in space. If the former is correct, we may be able to use superclusters to determine q_o. Observations of additional superclusters will be required to determine if either conclusion is correct.

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DISCUSSION

Abell: The conclusion that superclusters can be flat ("pancakes") is borne out by recent studies of nearby superclusters (Coma, Hercules, Perseus and the local supercluster) by Rood, Chincarini, Thompson, Gregory, et al.

Tyson: If you were to include a few of your "background" clusters as members of your superclusters, the redshift dispersion would easily reach 800 km/sec. Is there any evidence of a different number density on the sky of your "background" clusters and the general field?

Ford: The density of background clusters does appear to be higher than average near the two superclusters that we observed. If the nearest of the background clusters are associated with the superclusters, their geometrical shape becomes a cigar with a length-to-diameter ratio ~ 6. Inclusion of additional background clusters would make the superclusters even longer. We think that this geometry is sufficient evidence to exclude the background clusters from supercluster membership.