THE DYNAMICS OF THE LOCAL SUPERCLUSTER

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The primary reason for studying the dynamics of the local supercluster is for use as a local cosmological test (Silk 1974 Ap. J. 193, 525, Peebles 1976, Ap. J. 205, 318). In addition, the measurement of the mass enclosed in the local supercluster provides one of the best measurements of the M/L of galaxy systems on very large scales - a test of the hypothesis that M/L increases with radius for galaxy systems and thus a measure of the unseen matter (neutrino?) content of the universe.

As has been said of the whole of observational cosmology, the study of the dynamics of the local supercluster is "a search for two numbers." From the simple theoretical models we have a relation between the infall and the mean mass density of the universe:

$$V_p/V_H \simeq 1/3 \frac{\delta\rho}{\rho} \Omega^{0.66}$$

V_H is the velocity of the Virgo cluster, relatively easily measured, and Ω is the ratio of the mean density to the closure density. The numbers we must search for are V_p, the infall velocity at the Local group into the supercluster core (Virgo) and $\delta\rho/\rho$, the overdensity of the supercluster in a sphere of radius equal to the distance between Virgo and the Local group relatively to the background mean density. In almost all treatments to date the assumptions are made that the mass density is well traced by the luminosity density and that the supercluster can be treated by a spherically symmetric model. Non-spherical models by Hoffman and Salpeter have shown that this last assumption is reasonable.

Table 1 Estimates of the Local Group Infall Velocity

Global		
Microwave Background	390 km/s	(Boughn et al. 1981,Smoot & Lubin,1979)
IR-Tully-Fisher	480	(Aaronson et al. 1980, clusters)
E Galaxies	440	(Tonry and Davis 1981)
Sc I Galaxies	-140	(Rubin et al. 1976)
Luminosity Class	350	(de Vaucouleurs and Bollinger 1979)
Optical-Tully-Fisher	150	(de Vaucouleurs et al. 1981)

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Local		
Luminosity Function	230 km/s	(Yahil et al. 1980)
2nd moment	250	(Hoffman et al. 1980)
IR-Tully Fisher	280	(Aaronson et al. 1982, infall only)
" "	300	(" " " total motion)

A variety of estimates have recently been made of V_p. This can be broken down into "global" measurements made with respect to distant sources and local models that depend on measurement of distortion in the velocity field of the supercluster itself. A brief summary of recent results is given in Table 1; the references follow Aaronson et al. (1982, Ap. J. 258, 64). Note that we quote only the Virgo vector component for most global methods. The most sensitive of the local techniques is that employed by Aaronson et al. which uses the Infrared Tully Fisher method to directly measure distortions in the supercluster velocity field. This technique is independent of the absolute distances of galaxies; its particular application of minimizing velocity width residuals and calibrating by Monte-carlo simulations also handles Malmquist bias. Aaronson et al. have also detected evidence for a supercluster rotation component of 180 km/s at better than the 3 sigma level confirming an earlier suggestion by de Vaucouleurs. The difference between the amplitude of ~ 400 km/s seen in the best global measurements and the 250 km/s found by local techniques is not yet fully understood - it may require large-scale motion of the supercluster.

Two recent measurements of the supercluster overdensity $\delta\rho/\rho$ have been made by Yahil, Sandage and Tammann (1980 Ap. J. 242, 448) who find values of 2.7 to 3.5 from the RSA catalog, and by Davis and Huchra (1982 Ap. J. 254, 437) who find 2.1 from the CfA survey, a deeper and probably more fair sample than the RSA.

With the value of V_p ~ 260 from the local measures and $\delta\rho/\rho$ of 2.1, the value of Ω is ~ 0.2. This also gives a M/L on scales of 10+ Mpc in reasonably good agreement with the values found for groups of galaxies and the cores of rich clusters suggesting that M/L is not increasing with system size. With these parameters, we (the local group) is just marginally bound to the Virgo cluster.

Many problems still remain in the study of supercluster dynamics: the disparity between global and local measures of infall, detailed models based on the observed galaxy distribution, additional measurements of the distortion field using velocity independent distance indicators, and application of the models and methods derived for study of our supercluster to other superclusters.

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