PROFILES OF GALAXY CLUSTERS IN COSMOLOGICAL SCENARIOS

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We have studied the properties of rich clusters of galaxies in various cosmological scenarios by comparing high resolution N-body simulations with observations of Abell clusters. The clusters have been simulated in two steps. First, protoclusters are identified in large-scale simulations which represent a wide range of cosmological scenarios (hierarchical clustering, pancake scenarios, and hybrids of the two, spanning a range of power spectra). Then the region around each protocluster is simulated with high resolution, the particles representing L^* galaxies. The protoclusters have no spatial symmetry built into them initially. The final clusters are still dynamically young, and of moderate densities, which should be representative of Abell clusters of richness classes 1 and 2.

We find that the final cluster mass density profiles are quite similar in shape, independent of the initial conditions. The projected profiles are all well-fitted by the de Vaucouleurs $r^{1/4}$ law; their logarithmic slopes at the half-mass radius are about -1.8, and they steepen with increasing radius. The line-of-sight velocity dispersion profiles are also similar, and the velocities are quite isotropic. The existence of a universal profile suggests that violent relaxation is efficient at erasing traces of the initial conditions from the cluster profile during the first collapse, while secondary infall does not significantly affect it. Hence, the density profile is not a good indicator for the origin of the large-scale structure in the universe.

A comparison of the theoretical mass density profiles with the observed surface brightness profiles of a sample of 27 Abell clusters shows good agreement, suggesting that the radial cluster light distribution traces the mass distribution.

Other cluster properties (such as ellipticities, subclustering, binding energies, and others) are presently being examined, and preliminary results indicate that several of them may provide a more sensitive test for the formation of the large-scale structure. Detailed results of this work will be published elsewhere.

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