[구GC-05] Modeling the tidal connection between in and around galaxy clusters

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We analyze the halo and galaxy catalogs from the Millennium simulations at redshifts z=0, 0.5, 1 to determine the alignment profiles of cluster galaxies in terms of the matter density correlation coefficient and discuss a cosmological implication our result has for breaking parameter degeneracies. For each selected cluster, we measure the alignment between the major axes of the pseudo inertia tensors from all satellites within cluster's virial radius and from only those satellites within some smaller radius. Then we average the measured values over the similar-mass sample to determine the cluster galaxy alignment profile as a function of top-hat scale difference at each redshift. It is shown that the alignment profile of cluster galaxies is well approximated by a power-law of the nonlinear density correlation coefficient that is independent of the power spectrum normalization and bias factor. The alignment profile of cluster galaxies is found to have higher amplitude and lower power-law index when averaged over the larger-mass sample and to have rather weak redshift-dependence. This result is consistent with the picture that the satellite galaxies retain the memory of the external tidal fields right after merging and infalling into the clusters but they gradually lose the initial alignment tendency as the cluster's relaxation proceeds. Demonstrating that the nonlinear density correlation coefficient varies sensitively with the density parameter and neutrino mass fraction, we discuss a potential power of the cluster galaxy alignment profile as an independent probe of cosmology.

[구GC-06] Modelling the shapes of the largest gravitationally bound objects

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We combine the physics of the ellipsoidal collapse model with the excursion set theory to study the shapes of dark matter halos. In particular, we develop an analytic approximation to the nonlinear evolution that is more accurate than the Zeldovich approximation; we introduce a planar representation of halo axis ratios, which allows a concise and intuitive description of the dynamics of collapsing regions and allows one to relate the final shape of a halo to its initial shape; we provide simple physical explanations for some empirical fitting formulae obtained from numerical studies. Comparison with simulations is challenging, as there is no agreement about how to define a non-spherical gravitationally bound object.

Nevertheless, we find that our model matches the conditional minor-to-intermediate axis ratio distribution rather well, although it disagrees with the numerical results in reproducing the minor-to-major axis ratio distribution. In particular, the mass dependence of the minor-to-major axis distribution appears to be the opposite to what is found in many previous numerical studies, where low-mass halos are preferentially more spherical than high-mass halos. In our model, the high-mass halos are predicted to be more spherical, consistent with results based on a more recent and elaborate halo finding algorithm, and with observations of the mass dependence of the shapes of early-type galaxies. We suggest that some of the disagreement with some previous numerical studies may be alleviated if we consider only isolated halos.