[S14-4] Red Galaxies at High Redshift: Field vs. Cluster

Myungshin Im
Department of Astronomy/SEES, Seoul National University

According to hierarchical galaxy formation models, galaxy formation starts at high-sigma over-density peaks such as the places where cluster of galaxies reside, and then the formation of galaxies in low density environment follows. If this picture is right, early-type galaxies in clusters formed before the formation of field early-type galaxies. In order to examine this environmental dependence on galaxy formation, we study NIR-selected Extremely Red Objects (NERO) in field and near a known proto-cluster of galaxies at $z \simeq 2.4$. NEROs are galaxies with J-K color > 2 mag, and they are likely to be old, early-types or dusty, star-forming galaxies at z > 2. We find that there are more NEROs in the proto-cluster field as expected. From the Hubble Space Telescope data, the morphology of NEROs in field appears disturbed or irrgular suggesting that they are dusty star-forming galaxies. We constructed the spectral energy distribution of NEROs using the Spitzer Space Telescope data, and our spectral energy distribution analysis confirms that NEROs in field are predominantly dusty star forming galaxies, while NEROs in proto-cluster of galaxies contain a significant fraction of old, early-type-like galaxies. We also find that NEROs and HEROs (Hyper Extremely Red Objects) are quite massive ($> 10^{11} M_{\odot}$), suggesting that some massive early-type galaxies formed very early in the history of the universe.

[S14-5] Effects of Gravitational Evolution, Biasing, and Redshift Space Distortion on Topology

Changbom Park[1], Juhan Kim[1] and J. Richard Gott III[2]
[1]KIAS, [2]Princeton Univ.

We have studied the dependence of topology of large scale structure on tracer, gravitational evolution, redshift space distortion, and cosmology. A series of large N-body simulations of the ΛCDM and SCDM models that have evolved 1.1 or 8.6 billion particles, are used in the study. Evolution of the genus statistic, used as a topology measure, from redshift 8 to 0 is accurately calculated over a wide range of smoothing scales using the simulations. The tracers of large scale structure considered are the CDM matter, biased peaks in the initial density field, dark halos, and 'galaxies' populating the dark halos in accordance with a Halo Occupation Distribution model. We have found that the effects of biasing, gravitational evolution, and initial conditions on topology of large scale structure are all comparable. The redshift space distortion effects are relatively small down to about 5 h-1Mpc for all tracers except for the high threshold part of the genus curve. But the direction of gravitational evolution of topology can be even reversed for different tracers. At small scales there are interesting deviations of the genus curve of dark halos and 'galaxies' from that of matter in our initially Gaussian simulations. This fact gives us an important opportunity: topology of large scale structure can be used as a strong constraint on galaxy formation mechanisms.