[IS1] Cosmic Voids and Void Galaxies

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Wide-angle, moderately deep redshift surveys such as that conducted as part of the Sloan Digital Sky Survey (SDSS) allow study of the relationship between the structural elements of the large-scale distribution of galaxies-including groups, cluster, superclusters, and voids-and the dependence of galaxy formation and evolution on these enviroments. We measure the distribution of void sizes in the SDSS using an objective void finding algorithm and statistically characterize the spectrum of voids by measuring the Void Probability Function for volume-limited samples of this survey. These void statistics provide powerful constraints on models that describe the relationship between luminous and dark matter. The properties of galaxies in voids provide further contraints on galaxy formation models: Analysis of multi-band photometry and moderate-resolution spectroscopy from the SDSS reveals environmental dependence of the star formation history of galaxies that extends over more than a factor of 100 in density, from clusters all the way to the deep interiors of voids. On average, galaxies in the rarified environments of voids exhibit bluer colors, higher specific star formation rates, lower dust content, and more disk-like morphology than objects in denser regions. This trend persists in comparisons of samples in low vs. high-density regions with similar luminosity and morphology, thus this dependence is not simply an extension of the morphology-density relation. Large-scale modulation of the halo mass function partially explains this dependence of galaxy evolution on the large-scale environment.

[IS2] Infrared View of Galaxy Evolution

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Thanks to the new observing facilities such as the Spitzer Space Telescope (hereafter, Spitzer), we are now studying the formation and evolution of galaxies from a new wavelength window - infrared - to the unprecedented depth. I will review why infrared is essential for understanding the galaxy evolution, and present recent results from the Spitzer. By shedding a light on the dusty, dark side of the universe, the new observations have shown us the unexpected, downsizing nature of the galaxy formation/evolution: There are many massive, old galaxies already when the universe was very young, and massive galaxies start forming earlier than less massive galaxies. These results challenge the currently popular, hierarchical models of galaxy formation, and we expect to have a more complete understanding of the galaxy formation/evolution from future infrared observation facilities such as Astro-F, James Webb Space Telescope, and SPICA.