Constraining the Small-scale Clustering: Towards better understanding of Galaxy-light and Dark-matter connection

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Abstract

We propose an HST archival research to study the spatial clustering of Lyman-break galaxies at z ~ 4-5 at small scales (angular separation theta<30 arcsec, corresponding to spatial scales of about 1 Mpc comoving). Taking advantage of archival deep multi-wavelength images taken with the ACS, we will investigate the statistical association between the galaxy properties (e.g. star formation rate and morphology) and the dark matter properties (halo mass) by comparing the observed small-scale clustering and luminosity funtion to theoretical predictions. The existing ACS images, particularly those obtained as part of the GTO program, are an ideal resource for this research because of their depth, angular resolution and multi-wavelength coverage, which are crucial to identifying close galaxy pairs at high redshifts. Recent works, at both low and high redshifts, from deep, large-area surveys (e.g. SDSS, 2DF, GOODS, COSMOS) have discovered that there is a characteristic scale in the galaxy correlation function at which a transition of the correlation slope occurs. The steeper slope at small scales is interpreted as evidence of galaxy multiplicity, that is of the fact that massive halos develop substrucures in the form of "subhalos" which are themselves capable of hosting visible galaxies. At large scale, the shallower slope is determined by the halo-halo clustering, which reflects the power spectrum at linear scales. By comparing the observed distribution of separations and the luminosity function of close pairs of Lyman-break galaxies with those predicted by the theory we will test the validity of the models adopted to describe the physical association between halo and galaxy propeties, thus providing very powerful constraints to the theory. From this research, we will gain invaluable insights into what halo properties govern the physical processes of galaxy formation.

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