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Clustering of dark halos on the lightcone

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Abstract. We present a phenomenological model to predict the clustering of dark matter halos on the light-cone. The model is constructed by combining several existing theoretical models. We test our model against the Hubble Volume N-body simulation and examine its validity. A good agreement is found in two-point correlation functions of dark matter halos between our model predictions and measurements from the simulation. The model is quite general and thus can be applied to a wider range of astrophysical objects, such as galaxies and quasars.

1. Introduction

Clustering properties of luminous objects such as galaxies, clusters of galaxies and QSOs are useful tools in probing the cosmology. Large flows of data from the on-going 2dF and Sloan galaxy and QSO redshift surveys promise a precise measurement of the clustering properties of galaxies and QSOs. In this paper we present a theoretical model of clustering of *dark matter halos* expected along the past light-cone of an observer. We combine several existing theoretical models including nonlinear gravitational evolution, the peculiar velocities of halos, and halos biasing. We also include the light-cone effect (Suto et al. 1999) which is crucial when one analyzes data distributing over a broad redshift range. We test the resulting predictions against a light-cone output from the Hubble Volume simulations.

2. Two-point correlation functions on the light-cone

The most important ingredient in describing the clustering of halos is their biasing properties. We incorporate the scale-dependence which arises as a consequence of the formation epoch distribution of halos. The volume exclusion effect due to halos' spatial extension is also taken into account in the model,

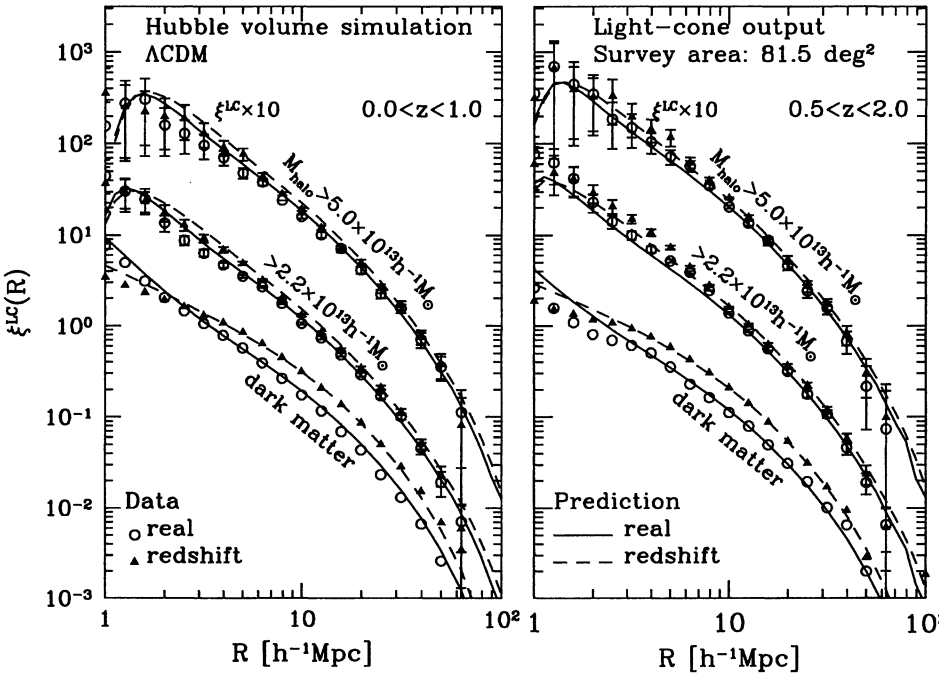

Figure 1. Two-point correlation functions of halos on the light-cone; simulation results (symbols; open circles and filled triangles for real and redshift spaces, respectively) and our predictions (solid and dotted lines for real and redshift spaces, respectively). Upper set is for halos with $M_{\text{halo}} \geq 5.0 \times 10^{13}h^{-1}M_\odot$, middle set for $M_{\text{halo}} \geq 2.2 \times 10^{13}h^{-1}M_\odot$, and lower set for the dark matter.

although in a very approximate manner (Hamana et al. 2001). The evolution of the halo peculiar velocities is approximated by linear theory.

The model predictions for the two-point correlation functions on the light-cone are compared with the measurement in the Hubble Volume simulation in Figure 1. The model agrees well with the two-point correlation functions of the simulated halos up to $z = 2$ in both real and redshift spaces. We anticipate that the model can be applied to studying clustering properties of various astrophysical objects, such as galaxies, clusters of galaxies and quasars, under model-specific assumptions for the relation between dark halos and luminous objects.

References

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