R51a Statistics of Hierarchical Merging Haloes and Galaxies

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We investigate the clustering and the bias effects of dark matter (DM) haloes with the skeleton tree formalism, which can analytically distinguish early merger and late accretion phases in the mass growth as urged in Hanami (2001, MNRAS, 327, 721). The formalism can analytically pick up the merging DM haloes at an epoch. The understandings on their mass growth and clustering to study the statistics of the haloes observed in recent N-body simulations; their universal density profiles, the concentration and the mass which are dependent on the shape of initial fluctuation spectrum, and the log-normal distribution of the concentration with scatters around the trend. First, we show the perspective of halo growth in describing (1) the bimodality in mass growth that the dominant mode switches from merger to accretion at a critical epoch, (2) its dependence on the slope of initial fluctuation, which is more obvious than the transition between the formation and the destruction of haloes in the number evolution, and (3) the probability distribution of the formation epoch, determined as a last merger on the trace-backed trajectory with accretion. Second, with understanding the halo growth in hierarchical clustering, we derive (4) a growing halo model reproducing the probability distribution of the concentration as a truncated log-normal distribution. Third, we can represent analytically the correlation functions of haloes in merging and accretion phases.

With the skeleton tree formalism, we will show some predictions for the statistical properties of protogalaxy candidates, which are recently observed like Ly break galaxies, Ly alpha emitters, and submm galaxies.