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Using Dark Matter Haloes to Learn about Cosmic Acceleration: A New Proposal for a Universal Mass Function

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Structure formation provides a strong test of any cosmic acceleration model because a successful dark energy model must not inhibit {\black or overpredict} the development of observed large-scale structures. Traditional approaches to studies of structure formation in the presence of dark energy or a modified gravity implement a modified Press-Schechter formalism, which relates the linear overdensities to the abundance of dark matter haloes it at the same time. We critically examine the universality of the Press-Schechter formalism for different cosmologies, and show that the halo abundance is best correlated with spherical linear overdensity at 94% of collapse (or observation) time. We then extend this argument to ellipsoidal collapse (which decreases the fractional time of best correlation for small haloes, and show that our results agree with deviations from modified Press-Schechter formalism seen in simulated mass functions. This provides a novel universal prescription to measure linear density evolution, based on current and future observations of cluster (or dark matter) halo mass function. In particular, even observations of cluster abundance in a single epoch will constrain the entire history of linear growth of cosmological of perturbations.

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