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NON-SPHERICAL COLLAPSE MODELS AND THE COSMOLOGICAL MASS FUNCTION

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The mass function of cosmological objects provides a useful tool for comparing theoretical models of structure formation with the observational data. The standard derivation of the mass function follows from the original work of Press & Schechter (ApJ,187,425,1974), and assumes a spherical collapse model. However, it is well known that the shear has a strong influence on the collapse, and the vast majority of the initial fluctuations evolve differently from the spherical ones.

Besides the well known Zel'dovich Ansatz (ZA, Zel'dovich, A&A,5,84,1970), several other approximations have been proposed to study the highly nonlinear evolution of the initial fluctuations without assuming any specific symmetry. Here we focus on the particular class of the *local lagrangian approximations*, which allow the computation of the mass function using a simple extension of the Press & Schechter approach (Monaco, ApJ,447,23,1995). There are only two approximations of this kind that are defined for any initial conditions and are exact for planar, spherical, and cylindrical symmetries, namely the Local Tidal Approximation (LTA, Hui & Bertschinger 1996) and the Deformation Tensor Approximation (DTA, Audit & Alimi 1996). For a compartive study of the local approximations see Makler et al. (ApJ,447,88,2001). In Figure 1 we show a plot of the mass function calculated with the ZA, DTA, LTA and the standard PS formula. For comparison, a fit to the mass function derived from N-body simulations (Jenkins et al., MNRAS 321, 372, 2001) is also shown in this graph. For large masses ($\Delta \lesssim 0.5$) the LTA and DTA are in better agreement with the N-body simulations than the PS result and the ZA. The position of the peak given by the local approximations is also in good agreement with the numerical simulations. However, its amplitud is overestimated compared to the N-body results.

Since the mass function is normalized to unity,

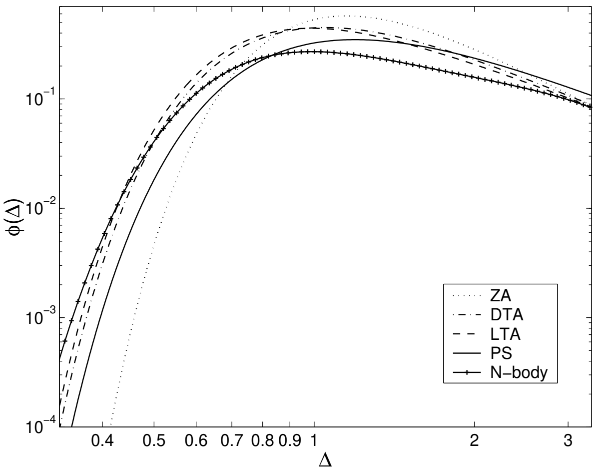

Fig. 1. The universal mass function calculated for the ZA, the DTA and the LTA. For comparison, we plot the fit to N-body simulations, together with the standard PS mass function.

this means that the local approximations underestimate the density of low-mass clusters. For the formation of these objects, processes like the fragmentation of larger clusters could be important. These effects are not taken into account using a purely local evolution. This discrepancy may also be a consequence of the different criteria used to determine the formation of an object. In the local approximations this is based only on the collapse time of an initial perturbation (first axis collapse), whereas in the mass function inferred from the N-body simulations the objects correspond to spherical virialized clumps, arising after the collapse of the three axis.

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