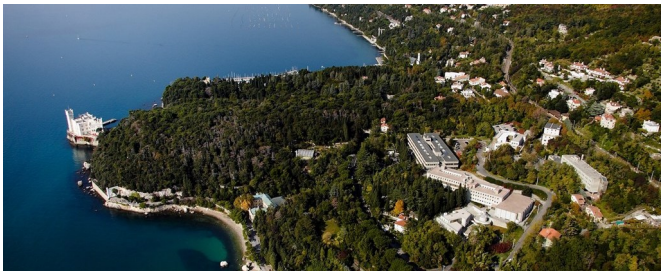

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Analytic modeling of probability distribution function for cosmological counts in cells

We study the one-point probability distribution function (PDF) for matter density averaged over spherical cells. The leading part to the PDF is defined by spherical collapse dynamics, whereas the next-to-leading part comes from the integration over fluctuations around the saddle-point solution. The latter calculation receives sizable contributions from short modes and must be renormalized. We propose a new approach to renormalization by modeling the effective stress-energy tensor for short perturbations. The model contains three free parameters. Two of them are related to the counterterms in the one-loop matter power spectrum and bispectrum, one more parameterizes their redshift dependence. This relation can be used to impose priors in fitting the model to the PDF data. We confront the model with the results of high-resolution N-body simulations and find excellent agreement for cell radii r<10 Mpc/h at all redshifts down to z=0. Discrepancies at a few per cent level are detected at low redshifts for r>=10 Mpc/h and are associated with two-loop corrections to the model.

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