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Winther: ”COLA with scale-dependent growth”

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N-body simulations is the main method we have to accurately compute observables in the non-linear regime of structure formation. Such simulations are too computationally expensive for many purposes, for example when one needs to generate large ensembles of galaxy mocks to model observables and their covariances for future surveys. Over the last few years a wide range of approximate methods for simulating structure formation have been proposed. I will first present a fast approximate method for including screening in numerical simulations of modified gravity theories and then show how one can extend the COmoving-Lagrangian-Acceleration (COLA) method to general models where the growth-rate is scale-dependent. These two methods can be combined and leads to a very fast method, often O(100) times faster than N-body, to compute clustering observables accurate down to fairly non-linear scales for a large class of models. Another application of the scale-dependent COLA method is that it allows for a simple way of including the effects of massive neutrinos on structure formation. The numerical code developed for this purpose is made available to the public and comes with several models already implemented.