

Numerical relativity methods for cosmological n-body simulations

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Cosmological structure formation is a highly non-linear phenomena which can only be tackle numerically. Current state-of-the-art cosmological code are based on Newtonian (or perturbative GR) gravity. Indeed, all approaches, even the gevolution code, reduce the Einstein equation to a set of modified Poisson equations. Only recently, simulation based on numerical relativity have been performed, but those simulations use a grid approach to simulate the dark matter fluid. If this approach is well suited for scales where the dark matter dynamic is purely linear, it is not adequate on non-linear scales due to the fact that shell crossing can not be tackled by such methods. In this talk, the numerical methods used by our new code will be discussed. This (not yet public) code uses a particle-mesh approach to solve the dark matter dynamic and numerical relativity to evolve gravity. The time integration of the system particles-gravity, the construction of cosmological initial condition, convergence tests and constraint violation will be discussed in details.