Julien Larena
Department of Mathematics, Rhodes University

A cosmological lattice model

Authors: Julien Larena

We study a cosmological model consisting of an infinite number of masses M placed on a cubic lattice of size L. The purpose of the study is to obtain a toy-model for a Universe made of localized masses, in order to test the usual fluid approximation of cosmology, as well as the Lindquist-Wheeler tesselated approximation that has recently been employed to explore the possibility to replace Dark Energy by an effect of inhomogeneities. We find a solution that is exact at order M/L, thus representing adequately a lattice of galactic-size objects separated by inter-galactic distances. The kinematics of the solution matches exactly the one of the corresponding Friedmann-Lemaitre-Robertson-Walker (FLRW) model with a dust matter component having the equivalent energy density. This supports the fluid approximation. Nevertheless, differences arise in the propagation of light and the values of observables, between the lattice model and the kinematically equivalent smoothed one. We comment on these effects and their potential observability, and we compare our results to the ones obtained in Wheeler-Lindquist models and in the FLRW context when using the Dyer-Roeder equation to take into account the clumping of matter.