

Master2 Internship proposal at CPT, year 2019

Research team: Cosmology

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Project title: Gravity in one dimension : a dynamical and statistical study

Description:

The evolution of structure in the cosmos is a complex process in which small-amplitude primordial density fluctuations grow and then collapse, under the action of gravity, to form bound structures. The equations governing these gravitational amplification processes are complicated, non-linear and must be solved by computers. The dynamical and statistical description of a system containing a large number of particles which interact gravitationally can be greatly simplified if spatial dimensions are reduced. A one-dimensional model for gravity provides an opportunity to study dynamical systems with long-range forces without relying on the numerical approximations required for higher dimensions. Because of its enormous computational simplicity this toy model may help in gaining theoretical insights to test conjectures concerning the mechanisms responsible for collapse, violent relaxation, thermalisation and dynamical stability of dark matter halos, the ‘invisible’ structures that host galaxies and cluster of galaxies in the universe. The proposed study will be essentially analytical. The main goal is to understand the fundamental physical principles that govern the dynamics of inhomogeneities in a 1D universe, derive theoretical predictions for the growth of 1D structures and compare them against numerical results obtained from one-dimensional N-body simulations.

References:

T. Padmanabhan, Statistical mechanics of gravitating systems, Physics Reports Volume 188, Issue 5, April 1990, Pages 285-362

Specify whether the internship project may naturally lead to a PhD thesis. yes