OSDC/PIRE Research Proposal

Title of Research: A new gravitational N-body simulation algorithm for investigation of cosmological chaotic advection.

Recently an alternative approach in cosmology seeks to explain the nature of dark matter as a direct result of the non-linear spacetime curvature due to different types of deformation potentials. In this context, a key test for this hypothesis is to examine the effects of deformation on the evolution of large scales structures. An important requirement for the fine analysis of this pure gravitational signature (without dark matter elements) is to characterize the position of a galaxy during its trajectory to the gravitational collapse of super clusters at low redshifts. In this context, each element in a gravitational N-body simulation behaves as a tracer of collapse governed by the process known as chaotic advection (or lagrangian turbulence). In order to develop a detailed study of this new approach we develop the COsmic LAgrangian TUrbulence Simulator (COLATUS) to perform gravitational N-body simulations based on Compute Unified Device Architecture (CUDA) for graphics processing units (GPUs).

This work also requires the usage of a GPU based Grid, including the construction and definition of a middleware capable of dealing with large set of hybrid hardware. COLATUS project is also building a consortium of Computational Science groups, in order to define and develop an Open Science environment that requires High Performance Computing.