N-Body simulations and the dynamics of the Solar System

Philip Sharp

Department of Mathematics

University of Auckland

Simulations of N bodies interacting are used extensively to model the dynamics of the Solar System. They are employed to investigate the long-term stability and possible migration of the planets, to distinguish between competing theories for the unfolding of the early Solar System and to study the evolution of different types of bodies, observed or hypothetical, including Near Earth Objects, short and long period comets, asteroids in the main belt, and Transneptunian Objects. The simulations are also used to generate ephemerides of newly discovered moons, and to investigate the transport of material from the outer to inner Solar System.

I will begin with an introduction to the above types of N-body simulations, and then describe the numerical methods for these simulations and how MPI can be used to achieve parallelism. The numerical methods will include hybrid, mixed-variable, Störmer and Runge-Kutta Nyström integration schemes, as well as the methods used to solve Kepler's equation.

I will provide many opportunities for audience participation.