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Study planets, exoplanets and small body dynamics in the Solar System with the GPU N-body code GENGA

DS and high-performance computing, e.g. work using the UBELIX cluster

Simon Grimm

Center for Space and Habitability

simon.grimm@csh.unibe.ch

Abstract

Solving the equations of motion for celestial bodies has been a century old problem. Beginning from calculating planetary positions, it has evolved to long term stability analysis of the Solar System, to planet formation simulations and more recently to exoplanet characterization. While the number of involved bodies constantly grows, the computational methods need to be constantly improved and optimized. Especially the use of highly efficient parallelization methods, combined with the most recent computer hardware play a crucial role.

The evolution of planets, planetesimals or other smaller bodies like asteroids or even dust particles, is dominated by the gravitational N-body problem. But besides pure gravity, also other forces must be considered, like tidal forces, general relativity, Yarkovsky effect or Poynting-Robertson drag.

Here, we present the latest developments of the GPU N-body code GENGA, which includes all the stated forces. We discuss the important parallelization techniques and compared also the performance between Nvidia GPUs, AMD GPUs and multicore CPU machines.