Toward *N*-Body calculations with a larger number of particles : parallel computation for Particle-Particle Particle-Tree scheme using FDPS

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Formation processes of terrestrial planets through planetesimal accretion have been studied using *N*-body calculations and several important formation processes have been found, such as the runaway growth and the oligarchic growth (Kokubo and Ida 1996, 1998). However, in almost all simulations the perfect accretion was assumed and relatively narrow region (e.g. 0.98AU-1.02AU) was simulated using small numbers of particles ($< 10^5$), because calculation cost is $O(N^2)$. To simulate planetary formation in more realistic conditions, it is necessary to take into account fragmentation, to handle a larger number of particles and to integrate them for longer time.
Therefore, we have developed a parallel implementation of P^3T(Particle-Particle Particle-Tree) scheme, which reduces the calculation cost from $O(N^2)$ to $O(N \log N)$.
In P^3T scheme, the gravitational force between two particles is split into short-range and long-range contributions. Short-range forces are evaluated by direct summation and integrated with the fourth order Hermite scheme with the block time steps. For long-range forces, we use a combination of Tree code and the leapfrog integrator with the constant time steps. Using this scheme, we can calculate *N*-Body problems accurately in low calculation cost of $O(N \log N)$. In order to accelerate P^3T scheme by parallel computation, we use FDPS(Framework for Developing Particle Simulator) which is a library to process the tree part at high speed.
In this talk, we show that it is possible to perform *N*-Body calculations for planet formation with a larger number of particles than those in the previous studies by parallel computation with P^3T scheme using FDPS.

Keywords: n-body simulations, planetary formation, planetesimals

