Giant impacts and terrestrial planet formation

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Collisions During Planet Formation

There are wide varieties of physical and chemical states among terrestrial planets, such as thier sizes, orbits, spin states (also presence of moon), the amount and composition of atmosphere, the presence of ocean and life etc. How have these varieties been built? Although the long-term evolutions on each planet are also important, we focus on the formation stage of the terrestrial planets. This is because very energetic events occur during the planet formation, such as the collisions among planetesimals [1] and protoplanets [2].

Especially, several tens of Mars-sized protoplanets collide with each other to form the terrestrial planets during the last stage of the terrestrial planet formation [3,4]. This stage is called the giant impact stage. Such energetic collisions should have a great influence on the various features of the terrestrial planets [e.g., 5-7].

Hybrid Code for Giant Impact Stage

We have developed the hybrid code that can handle both the long-term orbital evolutions of objects (N-body code) [8] and the short-term collision processes of objects (SPH code) [9]. Here, we apply this hybrid code to the last stage of terrestrial planet formation and investigate the effects of giant impacts on the features of the terrestrial planets.

Our hybrid code can handle histories of giant impacts such as change in core-mantle ratio, spin axis, spin velocity of protoplanets and so on. From the results of several tens of numerical simulations for giant impact stage, we will statistically discuss the basic physical characters of formed planets (e.g., the number, mass, and spin state of planets), and chemical characters (e.g., chemical and isotopic composition). We will also discuss the formation propability of Moon-like satellite and Mercury-like dense planet.

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