A Numerical Study of Collisions of Icy Bodies Using SPH Method

Miki Nakajima[1]; Hidenori Genda[2]; Shigeru Ida[3]

[1] Dept. Earth and Planet. Sci., Tokyo Tech.; [2] Earth and Planetary Sci., Tokyo Inst. of Tech.; [3] Dept. of Earth and Planetary Sci., Tokyo Inst. of Tech.

I have worked on collisions of icy bodies using Smoothed Particles Hydrodynamics (SPH) method, which is a powerful and widely used method to compute fluid dynamics, to understand effects of ice during collisions.

Through this research, I am going to figure out a basic behavior of ice during an impact. It has not been studied in detail yet, although collisions of icy bodies seem to frequently occur in the solar and extrasolar systems. On the other hand, collisions of Mars-size rocky bodies have been investigated well, because those collisions are related to the origin of the Moon and the formation of the terrestrial planets.

My SPH code has two special features. First, Gravity pipe computer (GRAPE) is used for calculations, which computes the gravitational force of each particle up to 100 times faster than usual computers. Second, for icy material, SESAME EOS database is used in order to build a more realistic model.

In this research, I focused on differences and similarities between collisions of icy bodies and those of rocky ones, such as merging criterion. Agnor & Asphaug (2004) have shown that a collision of rocky Mars-size protoplanets leads to an inelastic collision when its relative velocities are smaller than 1.4-1.5v, 1.1-1.2v, 1.1-1.2v at its impact angle=30, 45, and 60 degrees, respectively. Here, v means escape velocity. The same calculations for icy bodies are performed and they have shown that the merging criteria of icy bodies are the same as those of rocky bodies. Here, the number of particles I used is around 20000 and the ice-rock ratio of a icy body is 0.5.