# Merging Criteria for Planetesimal Collisions

*Takashi Shibata[1], Eiichiro Kokubo[1,2], Natsuki Hosono[3,4]

1. National Astronomical Observatory of Japan, 2. The University of Tokyo, 3. JAMSTEC, 4. RIKEN

Terrestrial planets, ice giants and the cores of gas giants are thought to be formed by the accretion of planetesimals. There is no research on the accretion process correctly evaluating the merging criteria at the time of planetesimal collision by using *N*-body simulation, while a recent study used the conditions of protoplanet merger. To properly know the accretion process of planetesimals, it is important to clarify the merging criteria of the planetesimal including the rebound. In this study, we investigate conditions that determine merger vs. rebound by numerically colliding undifferentiated rocky planetesimals, undifferentiated icy planetesimals, and differentiated icy planetesimals using Smoothed Particle Hydrodynamics. We vary the total mass, mass ratio, collision velocity, and collision angle of the colliding planetesimals. We investigate the critical impact velocity distinguishing merger from the rebound by a radical change of the largest remnant's mass represented against impact velocity. The critical impact velocity normalized by the escape velocity depends on the mass ratio of planetesimals and the impact angles. The critical impact velocity normalized by the escape velocity decreases with the target mass increasing relative to impactor mass, and decreases with increasing the impact angle whose maximum value shows us a grazing collision. The critical impact velocity is independent of the total mass of the planetesimals. This condition has a very small dependence on the composition and internal structure of the planetesimals. We formulate the critical impact velocity as a variable for the planetesimals' mass ratio and collision angle. We discuss the results above and show the change of planetesimal accretion process from the previous studies.

Keywords: Formation of planets

 