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Molecular dymnamics simulation of sticking process of sub-micron particles

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Dust collisional growth is the first step of the planet formation process, which is governed by adhesion forces frictions between sub-micron particles. Adhesion and inelastic interaction between nano- or submicron-sized solid particles are an important subject in many areas of technology and applied science as well as in astrophysics. However, detail of the particle interaction in such a size range has not been studied yet even for simple and homogeneous molecular systems. We examined interactions between small particles which consist of up to 100 millions of Lennard-Jones molecules, by performing molecular dynamics simulation. With molecular dynamics simulation, we can see clearly how the energy dissipation proceeds at collisions or rolling motions of particles. The figure shows the interaction force between two particles obtained from a MD simulation. This result almost agrees with JKR theory and also indicates that the interaction force has hystersis, which causes energy dissipation. I will further report the detail of the molecular dynamics simulations of particle collisions, rolling, sliding, and twisting and show results on comparisons with the previous theoretical models of particle interaction.

Keywords: cosmic dust, grain aggregate, planet formation, planetesimal, tribology