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Coagulation and radial drift of dust aggregates: the effect of porosity evolution

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Coagulation of dust grains is the first step towards planetesimal formation. A major obstacle is radial inward drift of macroscopic dust aggregates due to frictional coupling between gas and dust. Previous studies have predicted that the radial drift of meter-sized compact solid bodies is faster than their local collisional growth, suggesting a difficulty of direct collisional formation of planetesimals.

In this talk, we discuss how this picture can be altered by considering porosity evolution of dust aggregates. Recent laboratory and numerical experiments have revealed that dust grains evolve into highly porous aggregates as they experience low-energy collisions. The porosity evolution is important because porous aggregates have a large collisional cross section and hence a short growth timescale. We have for the first time simulated coagulation and radial drift of dust aggregates properly taking into account fractal evolution at low collisional velocities (Okuzumi et al. 2009) and collisional compression at higher velocities (Suyama et al. 2008). We find that macroscopic aggregates maintain a low internal density (typically $\sim 10^{-4}$ g/cc) in spite of the occurrence of the compression and are thus resistive to the radial infall. We plan to report this result and discuss an expected planetesimal formation scenario.

Keywords: dust aggregate, planetesimal formation, porosity evolution, radial drift