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Dust dynamics in RAMSES : Protostellar collapse and disk formation

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Dust grains are the building blocks of protoplanetary disks and planets. Dust regulates the thermal evolution of the disk through its opacity. In addition, it plays a major role in the coupling between the gas and the magnetic field, hence in the disk and jet formation. In observations, the polarized light emitted by the grains can be used to measure the magnetic fields orientation or to estimate the maximum grain size. Nevertheless the dust evolution remains poorly constrained during the early phases of star formation. The dependence of the drag force on the grain and gas properties can lead to a dynamical sorting, in particular for the large dust grains. Assumed to be uniform at low densities, the dust-to-gas can increase up to large values during the protostellar collapse that leads to the protostar and disk formation (Bate and Loren Aguilar 2017, Lebreuilly et al. 2019). I will present our dust dynamics algorithm (Lebreuilly et al, 2019) in the adaptive-mesh-refinement code RAMSES (Teyssier 2002) and first collapse simulations of gas and dust mixtures with a simultaneous treatment of multiple grains species of different sizes (Lebreuilly et al, in prep). I will show how the dynamics of the dust phase during the first protostellar collapse can lead to an important increase of the dust-to-gas ratio and how this sorting depends on the initial properties of the core.

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