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Dust circulation in self-similar protoplanetary discs

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Planetary formation presents many unanswered questions which are very difficult to answer, observationally since they are deeply embedded, theoretically due to the very nonlinear dynamics and computationally due to the hundreds of thousands of orbits over which the formation occurs. Current models of the early solar system have difficulties explaining the existence of dust reservoirs observed in meteorites, how to overcome the metre barrier among other questions pertaining to dust dynamics.

We present a new efficient method for simulating massive particles in 3 dimensions for millions of orbits, using realistic dust friction and turbulence modelling. Applying this method to a simplified protostellar disc model, we find interesting out-of-disc trajectories where particles are “carried” by the outflow, allowing the particle to circulate for much longer than simple in-disc calculations would predict. These dynamics are qualitatively resilient to the friction model, as well as significant turbulent perturbations.

In the future this opens the possibility of studying dust dynamics in large scale 3d MHD models, hopefully offering new insight into the early solar system.

Field of study

Astrophysics

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Session Classification: Poster session: Enjoy the posters!!!