4. – Granular physics and accretion discs

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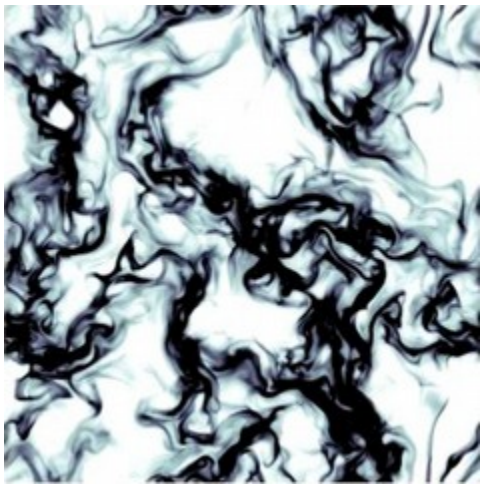
Project details



Granular materials are invaluable to industry and are ubiquitous in our daily lives: from dry rice and spices to raw materials. A freely cooling granular gas is an ensemble of particles undergoing dissipative collisions and free of any external field. Such granular gases have been used as model systems to describe geophysical processes such as the solar corona, the asteroid belt between Mars and Jupiter, planetary rings, protoplanetary disks, and the formation of cosmological structures. Even a small degree of dissipation in the kinetics of granular particles produces spatial correlations and structures in a dilute, homogeneous gas.

Granular gases can be treated hydrodynamically by means of appropriately modified Navier-Stokes (NS) equations. The granular NS equations can be derived from a Boltzmann equation by taking into account the granular kinetics and then follow the Chapman-Enskog method. My group has developed a state-of-the-art computational fluid dynamics code for solving the granular Navier-Stokes equations, which we implemented with CUDA for GPU accelerators. The student will employ such tools to realistic astrophysical conditions that will open new vistas on the processes leading to planet formation.

The student will join an interdisciplinary group that focuses on nonequilibrium statistical mechanics. We are seeking an outstanding, industrious student with a background in physics, applied mathematics, or related fields. Prior experience on computer programming is not necessary, but mastering languages like C and python will be key to the success of the project.

Entry requirements:

Applicants should have, or expect to achieve, at least a 2:1 Honours degree (or equivalent) in physics, applied mathematics, or related subjects. Some experience in programming languages like C/C++ or Python, or experience in e.g. Matlab with a desire to learn other languages, is a necessary prerequisite. Experience in one or more of the following subjects will be an advantage: mathematical modelling, Brownian motion, fluid mechanics or differential equations in various applications.

References

C. Singh and M. G. Mazza, "*Electrification in granular gases leads to constrained fractal growth*", Sci. Rep. **9**, 9049 (2019).