Passive tracers in a sea of magnetic rollers

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Academic level: Licence or Master.
Experimental techniques: Lagrangian tracking.

Motivations and context

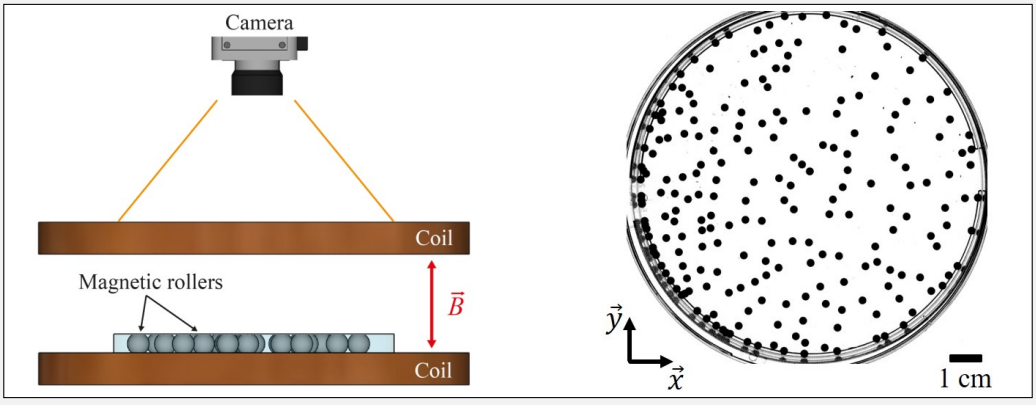
Granular gases are many-particle systems in which individual particles undergo random motions, the dynamic of which differs from molecular gases due to the energy loss during inelastic collisions [1]. The inelastic collisions between the particles imply that granular gases are dissipative and require a constant input of energy to compensate for the loss of kinetic energy. This project aims to study how the granular gas particles transfer linear and angular momentum to a passive tracer and how the velocity distributions of these passive tracers are linked to the state of the granular gas. We will check whether the theoretical model based on Onsager's minimum rate of dissipation principle, observed in micro-gravity [2], is valid in a different system.

Research focus

This project focuses on the dynamics of a few passive particles placed in a 2D granular "gas" made of magnetic rollers. The velocity distributions of both the rollers and passive particles will be studied using tracking techniques. We will analyze these distributions for an increasing particle density. We aim to show that the dynamics of a few tracer particles appear to be a simple and accurate tool for understanding the dynamics of the granular gas system.

Experimental system

Left: schematic of the laboratory experiment. The magnetic rollers' radius is 2 cm. A vertical oscillating magnetic field energizes these centimetric magnetic rollers. The vertical magnetic field is generated by a pair of Helmholtz coils. The rollers are illuminated from the bottom by a light-emitting diode (LED) panel, and a high-speed camera records time series of images. Right: snapshot of the magnetic rollers in a circular container.



References

[1] T. Pöschel and S. Luding, Granular Gases (Springer, Berlin, 2001).
[2] M. Noirhomme, A. Cazaubiel, E. Falcon, D. Fischer, Y. Garrabos, C. Lecoutre-Chabot, S. Mawet, E. Opsomer, F. Palencia, S. Pillitteri, and N. Vandewalle, Phys. Rev. Lett. **126**, 128002 (2021).