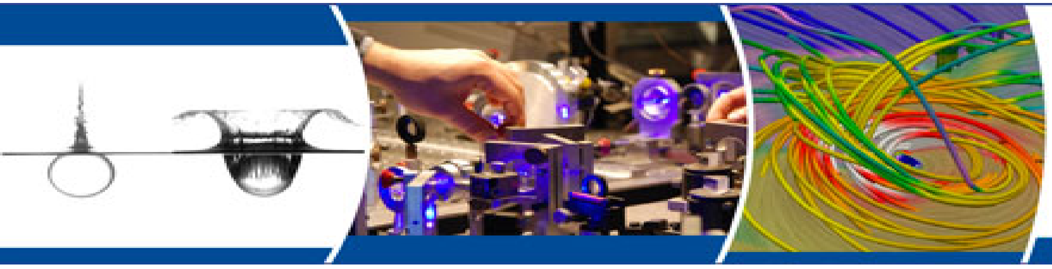


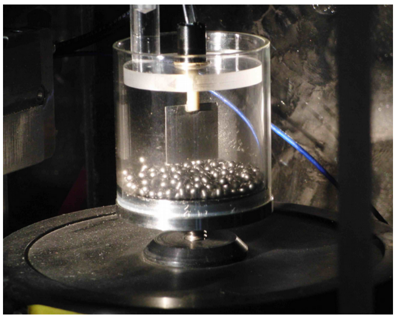
ED 52 - PHAST
Physique & astrophysique de Lyon
Ecole doctorale

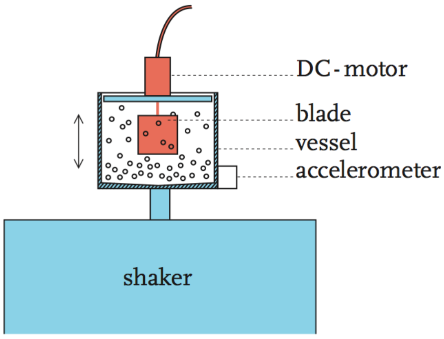
2020 Master internship, may be extended on a PhD thesis:

Non-Equilibrium Statistical Physics in macroscopic dissipative systems.

Location : Laboratoire de Physique, ENS-Lyon, France
Supervision: Antoine Naert (antoine.naert@ens-lyon.fr)

Context: Stochastic thermodynamics, which describes fluctuation dominated dynamic states, is in full swing. However, experimental contributions are still recent and few. In our lab, model experiments are carried out, a priori technically simple, as test benchmarks for theoretical propositions and to possibly inspire developments in the field.
In this simplistic perspective, we develop, for instance, a study of 'Brownian motion of a macroscopic rotor' in granular gases, or hydrodynamic turbulence, but also wave turbulence in thin vibrated plates [5].
We have verified that certain theoretical propositions describing equilibrium processes are still valid in such systems where yet part of the energy is dissipated: Fluctuations Theorem [1], Fluctuation-Dissipation Theorem [2], Hatano-Sasa equality [3] (which generalizes the Clausius inequality), and some transport properties [4].
Through these different experiments, we have defined and measured the 'temperature' $kT_{eff.}$ of a non-equilibrium steady state (NESS), which shows values around 10^{-9} and 10^{-6}J typically. These *effective temperatures* are considerably larger than those of molecular systems ($k_BT \sim 10^{-21}$ J).
We thus realize at the macroscopic scale behaviors that are specific to the molecular scale!…





Subject: We perform experiments in granular gases, but not only, which have been focused on stationary properties. We now want to broaden the research and explore not only the non-stationary dissipative states (transients), but also the relationship between information theory and non-equilibrium statistical physics.

An interested student must like statistical physics and especially experimental work. He or she will also need to have a practical mind because part of the work will be instrumental design.

Keywords: Stochastic thermodynamics, irreversibility / dissipation, entropy production rate, house keeping heat / excess heat, Landauer principle, Maxwell daemons, energy / information conversion, etc.

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