M2 Research internship

Collective dynamics of heated colloidal particles

The dynamics of colloidal particles in solution is now understood since the pioneering work of Langevin, more than a century ago. A recent unique situation has emerged, when the colloidal particles are heated by a short laser pulse, driving the system **out of equilibrium**. In this situation, the particles act as small sources of heat interacting together, and the resulting dynamics is not yet understood [1]. One might expect a rich phenomenology involving the coupling between heat diffusion and Brownian motion, and the possibility to control the effective interactions between the particles through the laser. Apart from the fundamental aspect, this situation is also important for biomedical applications [2].

The goal of the internship is to study this collective dynamics on the basis of a **stochastic model.** To this end, the student will solve a **Smoluchovski** equation coupled to classical heat diffusion equations. These equations will be solved numerically using a simple finite difference code and/or Brownian dynamics simulations, depending on the taste of the student. He/she will aimed at finding situations where the particles form clusters. These calculations are of interest for the experimentalists working in the ILM Institute.

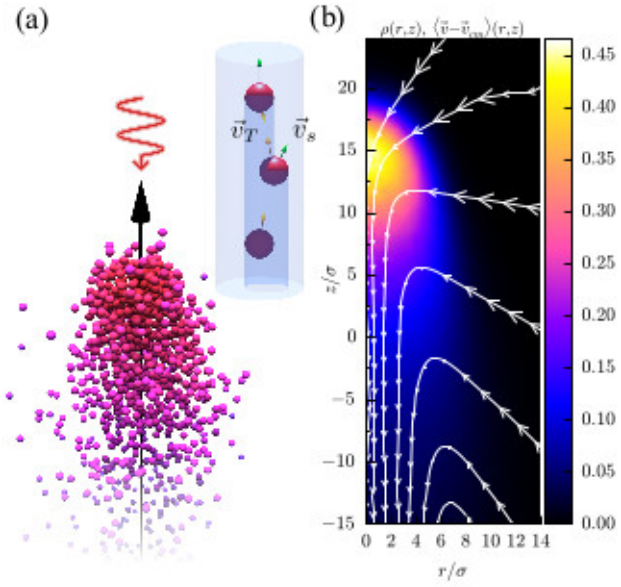

Figure: sketch of the system studied. An ensemble of colloidal particles heated by a laser pulse. From [1].

[1] Emergent cometlike swarming of optically driven thermally active colloids, JA Cohen, R Golestanian *Physical Review Letters* **112**, 068302 (2014).

[2] Kinetics of nanobubble generation around overheated nanoparticles, J Lombard, T Biben, S Merabia *Physical Review Letters* **112**, 105701 (2014).

Opening toward a PhD : yes (funding with «bourse ministère»)

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