University of Fribourg / Faculty of Science and Medicine / Department of Physics

Colloidal suspensions driven out of the equilibrium

Scacchi Alberto

Soft Matter Theory is a branch of physics focusing on the theoretical aspects of soft matter. The term “soft matter” is usually used to describe materials that are easily deformed by external forces and thermal fluctuations, like for example milk, blood, paint, toothpaste, gels, foams, ice cream and many others. In this work we focus on those materials composed by colloids suspended in a background fluid, shortly called colloidal suspensions. These materials are relevant in many industrial and pharmaceutical applications. As well, fundamental aspects of such suspensions are still unknown and call the attention of many scientists. In this manuscript a special effort is made to study the non-equilibrium aspects of such suspensions in the case of external drive.

The mathematical tools used in this thesis are the Density Functional Theory (DFT), Dynamical Density Functional Theory (DDFT) and Brownian Dynamics simulations (BD). An introduction on these topics is given in the first chapters of this manuscript. We then report the different research results published in various scientific journals. The main phenomena reported here are the liquid-gas phase transition induced by external drive on a curved surface, the local liquid-crystal phase transition induced by external drive and, more generally, the rheological responses of colloidal suspensions under simple shear (laning transition) and Poiseuille flow (particles migration).

The different results has been published in peer-reviewed journals.

Jury:

Prof. Dr. Joseph M. Brader, thesis supervisor,
Prof. Dr. Andrew J. Archer, external co-examiner,
Prof. Dr. Frank Scheffold, internal co-examiner,
Prof. Dr. Christian Bernhard, president of the jury.