

Research Topic for the ParisTech/CSC PhD Program

Subfield: Active Matter, Gels, Paste, Emulsions, Soft Matter, Material Science

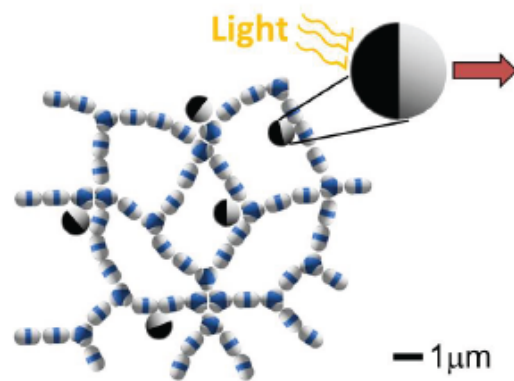
ParisTech School: ESPCI

Title: Soft Active Solids

Advisor(s): Olivier Dauchot, olivier.dauchot@espci.fr, <http://www.ec2m.espci.fr>

Short description of possible research topics for a PhD

While active fluids consisting of small self-propelling particles have opened recently a new domain in non-equilibrium physics, their solid counterparts remain completely unexplored. While driven solid architectures are common in living matter e.g. in our own tissues, where molecular motors stiffen and contract biopolymer networks, their physics remains poorly explored. This project aims at tailoring artificial systems that combine activity and elastic architecture, and unraveling their emergent collective behaviour, e.g. locomotion, shape changes and unusual transport properties.



The project will focus on microscopic scale experiments carried out on active colloidal structures.

The goal is to start with known soft materials such as gels, emulsions or paste, dope them with active janus colloids and devise experimental strategies to probe the onset of nonlinear motion and active elastic instabilities in such active architected materials.

Required background of the student: You are currently in a Master's track in physics, engineering, chemistry or a related field. You have outstanding skills for experimental physics and a voracious appetite for learning new techniques. You have excellent written and oral communication skills in English.

A list of 5 (max.) representative publications of the group: (Related to the research topic)

1. Briand, G. & Dauchot, O. Crystallization of Self-Propelled Hard Discs. *PRL* **117**, 098004–5 (2016).
2. Coulais, C., Seguin, A. & Dauchot, O. Shear Modulus and Dilatancy Softening in Granular Packings above Jamming. *PRL* **113**, 198001 (2014).
3. Izri, Z., van der Linden, M. N., Michelin, S. & Dauchot, O. Self-Propulsion of Pure Water Droplets by Spontaneous Marangoni-Stress-Driven Motion. *PRL* **113**, 248302 (2014).
4. Bricard, A., Caussin, J.-B., Desreumaux, N., Dauchot, O. & Bartolo, D. Emergence of macroscopic directed motion in populations of motile colloids. *Nature* **503**, 95–98 (2013).
5. Deseigne, J., Dauchot, O. & Chaté, H. Collective Motion of Vibrated Polar Disks. *Phys. Rev. Lett.* **105**, (2010).