Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire de Physique des Solides (LPS)
CNRS identification code: UMR-8502
Internship director surname: Smallenburg
e-mail: frank.smallenburg@universite-paris-saclay.fr Phone number: -
Web page: http://frank.smallenburg.nl https://www.lps.u-psud.fr
Internship location: LPS, Orsay

Thesis possibility after internship: YES
Funding already obtained for a PhD: NO If YES, which type of funding:

Self-assembly of rod-shaped nanoparticles

A fascinating way of creating new materials is via the spontaneous self-assembly of nanoparticles. When suspended in a solvent, these particles perform Brownian motion, allowing them to explore phase space and form different phases, similar to atoms and molecules. In the presence of attractions, or at high enough densities, this can lead to intricate crystal structures, dependent on the shape of the nanoparticles and the interactions between them. Even more complex structures can be formed by confining the nanoparticles in microscopic cavities, leading to a complex interplay between the thermodynamic bulk phase that the particles ``want'' to form, and the constraints imposed by the boundaries of the volume available to them [1]. This project explores the self-assembly of nanoparticles in confinement, in close collaboration with experimental work in the group of Cyrille Hamon (LPS). In particular, you will explore how the aspect ratio of nanorods impacts the structures they form in confinement.

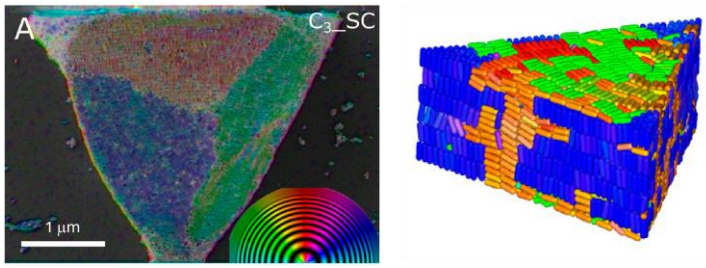

Figure: Experimental (left) and simulated (right) self-assembled structures of nanorods in confinement. Taken from Ref. [1].

In this project, you will write and perform simulations aimed at investigating the self-assembly of rod-shaped nanoparticles in confinement, and analyze the self-assembled structures in order to compare these simulations to experiments. You will learn about the physics of self-assembly, how to simulate anisotropic particles, and how to analyze structural organization in many-body systems. The ideal candidate has a strong background in statistical physics, as well as an affinity for coding and/or computer simulations.

[1] W. Chaâbani, J. Lyu, J. Marcone, C. Goldmann, E. J. M. ten Veen, C. Dumesnil, T. Bizien, F. Smallenburg, M. Impéror-Clerc, D. Constantin, and C. Hamon, *ACS Nano* **18**, 9566 (2024).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: NO Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: YES