Doctoral positions
2017-2018

Thesis supervisor

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Thesis topic

Liquid Crystal composites for a microgravity study

The general context of the PHD proposed here is « Microgravity studies of nanoparticles and topological defects in liquid crystal thin films », already approved by NASA under program NNH15ZTT002N. This is an experiment to fly aboard the International Space Station (ISS) in the very early 2020s. The PHD would be shared between Université Pierre et Marie Curie (E. Lacaze / NASA-approved co-Investigator) and Case Western Reserve University (C. Rosenblatt / NASA principal investigator). The project consists in studying composites of liquid crystal topological defects / fluorescent nanoparticles in a microgravity environment. This experiment will simultaneously address the question of topological defect dynamics followed by fluorescent nanoparticles trapped by the defects and the dynamics of the trapping phenomenon itself. The aim is to use the data for an in-depth understanding of these two dynamics, in relation with accurate models that take into account the nanometer scale defect structure, in the absence of influence of an underlying substrate or a surrounding particle reservoir. In consequence the measurements must be performed with microbubbles in a microgravity environment to minimize boundary issues that are seriously impacted by gravity.

The PHD student will start the PHD in October 2017 and will address the following points, combining experiments and theoretical models:

- Building of an intermediate set-up based on planar free-standing films in which the surrounding meniscus will be ignored in a first step.
- Study of the dynamics in composites systems composed of smectic C films and fluorescent nanoparticles.
- Variation of temperature and of size/shape of the nanoparticles to continuously control the nature of the topological defects and of the trapping characteristics of the defects.
- Set-up of first order models, neglecting the influence of the meniscus for a first comparison with experimental data.
- Transfer of the composite system to microbubles in air to estimate the limiting time where gravity becomes dominant.
- preliminary experiments in parabolic flights
- Preparation of experiments for flight aboard the ISS and analysis of the data.

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