université de BORDEAUX

UMR5798
Laboratoire Ondes et Matière d'Aquitaine

Master 1/2 Internship

Title: Liquid crystal encoding assisted by light.

Supervisor(s): Delphine Coursault
Email(s): delphine.coursault@u-bordeaux.fr;

Project:

Liquid crystals are viscoelastic anisotropic fluids known for the diversity and versatility of the orientational order of their molecules. When the orientational order is constrained or frustrated, one can use an external stimulus to reorient the molecules and localized topological structures with particular properties may appear, see Figure 1 below. [1] Our goal here is to create and control the morphogenesis of numerous self-organized topological structures that can be viewed as "colloidal-like" particles. Then, we will be able to investigate interactions and dynamics of a new out-of-equilibrium system made of collections of objects of various nature. With that aim, we actually want to exploit the light-matter interaction using all light field properties: polarization, phase and amplitude.

Our team showed recently that the angular momentum of the light allows to impart a chiral character to liquid crystal topological structures by twisting the medium (Figure 1). This results from momentum conservation principle with a transfer of angular momentum from the light to the liquid crystal medium. Recalling that the mechanical effect of the angular momentum is independent on its nature, we are exploring the influence of both spin angular momentum - related to light polarization- and orbital angular momentum - related to phase field distribution (associated with optical vortices) - on the liquid crystal reorientation. Phase distribution is related to spatial degree of freedom, and so is the amplitude field distribution of an extended light beam. Hence, we also want to explore our ability to sculpt orientational structures by patterning the illumination of a photo-active electro-optical device, so called "liquid crystal valve".

In this project, you will perform parametric investigations (influence of the illumination size, distribution, power, the boundary conditions…) to generate localized topological structures with controlled chirality by varying the nature of the light-matter interaction.

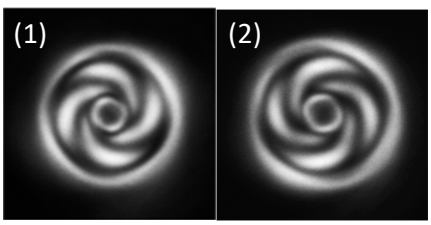

Figure 1: Optical microscopy images between crossed linear polarizers. Dark areas show no reorientation of the liquid crystal molecules. (1) left-handed topological structure (2) right handed topological structure.

[1] C. Loussert and E.Brasselet, Multiple chiral topological states in liquid crystals from unstructured light beams, Applied Physics Letters 104, 051911 (2014).