Master 1/2 Internship

Title: Spin-controlled rewritable memory in liquid crystal droplets.

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PhD opportunity: yes depending upon success of various grant applications.

Project: Liquid crystals are viscoelastic anisotropic fluids known for the diversity and versatility of the orientational order of their molecules. One can play with boundary conditions (normal, planar…) at the interfaces to control liquid crystal elastic distortion, and thus constrain or frustrate the orientational order. The constraint can then be released by applying an external stimulus, such as an electric field or a light beam, to reorient the molecules[1]. Localized topological structures with particular properties may appear.
Hence our team showed recently that the angular momentum of a pump light can be imprinted and recorded within liquid crystal topological structures (see Figure 1a). This rises from momentum conservation principle with an asymmetric transfer of angular momentum from the light to the liquid crystal medium. The phenomenon actually leads to record polar topological structures. As such, the nature of the imprinted light polarization can be readout as the probe light passing through the structures focuses at different planes. We created spin-controlled soft-memories (Figure 1-right panel) in analogy with optically controlled magnetic memories [2].
Until now our study was performed in planar geometry within a continuous liquid crystal film. In this project, we will extend our investigation to 3D confinement (spherical geometry) in order to further exploit the richness of liquid crystal topological properties. We will investigate the recording of light polarization in 3D structures, liquid crystal droplets, dispersed in a viscous host fluid. You will perform parametric investigations (droplet size distribution, light power and polarizations, the boundary conditions, viscosity of the host fluid, …) to generate on demand localized topological structures by varying the nature of the light-matter interaction.

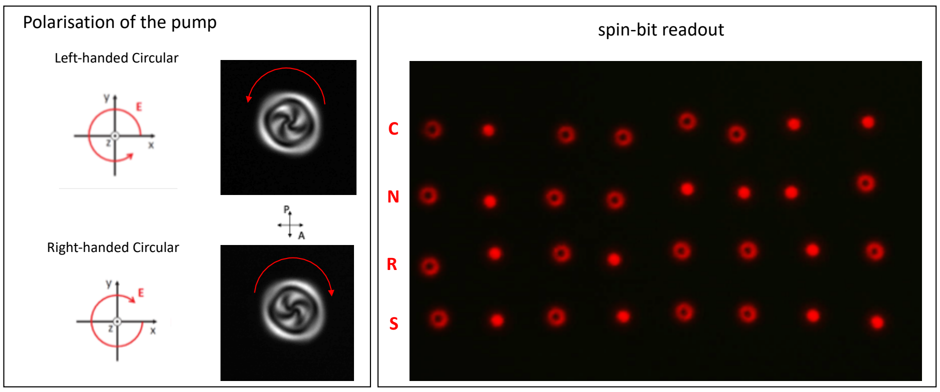

Figure 1: Optical microscopy images between crossed polarizers. Dark areas show no reorientation of the liquid crystal molecules. (Left Panel) (top) left-handed topological structure (bottom) right handed topological structure. (Right Panel) 8-bit readout of the word "CNRS" using the left handed and right handed imprinted topological structures.

[1] C. Loussert and E.Brasselet, Multiple chiral topological states in liquid crystals from unstructured light beams, APL 104, 051911 (2014). [2] Kimel & Li, Nat. rev. mat. 4, 189–200 (2019).

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