Master Internship/PhD

Title	**Tomography Imaging of Luminescent Nanocrystal Self-Assembly**
Location	Laboratoire PMC – Ecole Polytechnique – Route de Saclay – 91128 Palaiseau
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Nanoparticles can self-assemble to form superstructures. Various high-tech materials and devices are made today by applying the natural or externally directed self-assembly of functional nanoparticles (e.g. metamaterials, photonic crystals, liquid crystal displays, drug delivery medicines…). However, there exists no straightforward method to directly observe the synchronized dynamic movement of nanoparticles during the self-assembly process. The current techniques using electron microscopies (SEM, TEM, etc) is only available in limited environments such as under vacuum, and the X-ray analysis only provides global information on macroscopic domains. This project aims to perform a novel *in-situ* optical method to monitor the self-assembly of nanocrystals in colloidal solution.

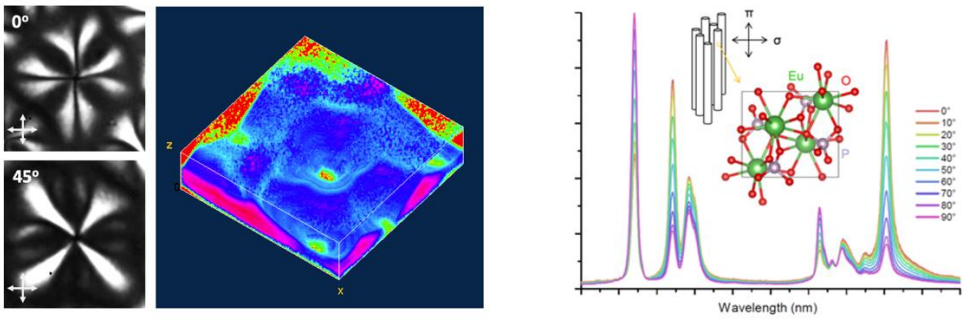

Figure: *Left*: Flower-shaped nematic phase domain structure made of luminescent nanorods
Right: Polarized photoluminescence spectra of the Europium-doped nanorods [1].

We recently developed a colloidal nanocrystal system exhibiting an unprecedented self-assembly behavior. Our rod-shaped nanocrystals spontaneously align together into a liquid crystalline (LC) nematic phase with a flower-shaped domain morphology (Figure-*left*). This new self-assembly structure is of high interest for fundamental understanding of energy balancing in LC systems, and also for applications in novel electro-optical devices. In order to characterize the assembly structure, the nanocrystals are doped with lanthanide ions exhibiting polarized photoluminescence (Figure-*right*) [1], from which the detailed information of their position and orientation can be measured [2]. This internship project aims to make a tomographic imaging analysis of the self-assembly structures by using the confocal microscopy technique combined with the polarization-resolved spectroscopy. The imaging will be performed *in-situ* during the self-assembly process and the LC phase evolution. This study will help understanding of the collective dynamics of interacting colloidal nanoparticles and can also be applied to practical applications such as in microfluidic analysis [3]. *This internship can be continued as a PhD thesis.*

Techniques to be used: Soft colloid chemistry, Scanning confocal microscopy, Fluorescence spectroscopy, Basic characterizations (SEM, XRD, DLS), etc.

[1] E. Chaudan et al, *J. Am. Chem. Soc*. 140, 30, 9512-9517 (2018)

[2] J-M Kim et al, *Nature Communications*, 12, 1943 (2021)

[3] J Kim et al, *Nature Nanotechnology*, 12, 914-919 (2017)