INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire Lumière, Matière et Interfaces (LuMIn)
CNRS identification code: UMR 9024
Internship director'surname: Dr. Elsa Cassette / Pr. Emmanuelle Deleporte
e-mail: elsa.cassette@ens-paris-saclay.fr ; emmanuelle.deleporte@ens-paris-saclay.fr
Phone number: 0169352139
Web page: https://www.noos.universite-paris-saclay.fr/
Internship location: Building 505, rue du belvédère, 91400 Orsay (plateau)

Thesis possibility after internship: YES
Funding: NO If YES, which type of funding:

Collective emission from quantum-confined nanostructures toward superradiance

Keywords: (multi)excitons, halide perovskite superstructures, ultrafast optical spectroscopy, giant oscillator strength, exciton- phonon coupling, (in)homogenous linewidth

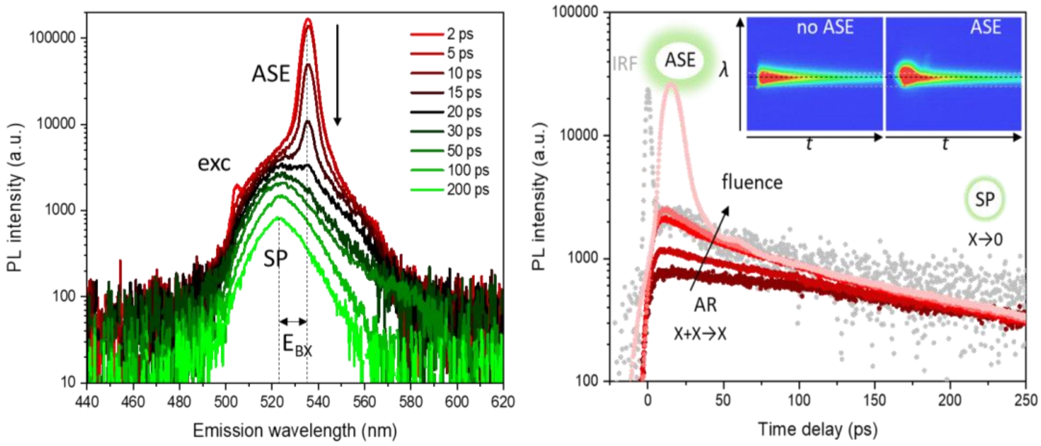

Figure: TR-PL spectra and decay traces of CsPbBr3 nanocrystal film at room temperature (RT).

Description: Halide perovskite nanocrystals are of particular interest for the development of several opto-electronic applications including light emitting devices (LEDs and lasers). However, using these nano-emitters for controlled collective effects such as superradiance (SR) or superfluorescence (SF) is still a challenge [1,2]. This internship aims to study the collective photoemission process from ordered superlattices of halide perovskite nanocrystals (0D) and nanoplatelets (2D). The student will investigate the interactions between emitters coupled through dipole-dipole interaction (from FRET energy transfer to supperradiance/superfluorescence), amplified spontaneous emission (ASE) and multiple exciton processes from non-radiative Auger recombination (AR) to radiative biexciton (BX) emission. She/he will use ultrafast spectroscopy technics to disentangle the signals from all these processes, toward the final goal to obtain coherently coupled emitters within the superstructures.

Methods and techniques: Time-resolved photoluminescence (TR-PL) with a picosecond streak camera and home-made femtosecond transient absorption, both based on an amplified TiSa laser source. Measurements at room- and cryogenic- temperatures, for various excitation fluence. Nanostructures will be synthesized by our colleagues within the research group.

Requirement: Background in Physics: nonlinear Optics, Quantum Mechanics and Solid-State Physics

References: [1] G. Raino et al., Nature 2018, https://doi.org/10.1038/s41586-018-0683-0
[2] C. Qin et al., Nature 2020, https://doi.org/10.1038/s41586-020-2621-1

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

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