INTERNSHIP PROPOSAL

Laboratory name: Institut des NanoSciences de Paris
CNRS identification code: UMR 7588
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Internship location: Jussieu, Tower 22, corridor 22-32, 5th floor

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ANR ot ED

Spectral broadening of single colloidal nano-emitter under high excitation

CdSe/CdS core/shell nanocrystal are excellent bright nano-emitters, awarded by the Nobel Price 2023. At room temperature, they behave as high quantum efficiency single photon source thanks to the electronic confinement and efficient Auger processes. Single photon emission can be described by the recombination of a single exciton within a simple two-level system. Under low excitation power at room temperature, the emission linewidth is approximately $\Delta\lambda \approx 20$ nm. However, by increasing the excitation power, emission spectrum broadens dramatically up to $\Delta\lambda \approx 150$ nm (Fig1a). Moreover, the emission intensity grows non-linearly with increasing excitation power [1][2]. The two- levels system paradigm fails for interpreting those features. We have recently developed a model based on the radiative recombination of multiple excitonic levels within a single nanocrystal , relying on statistical description[3] of electron and hole populations in a quasi-equilibrium and on their recombination.

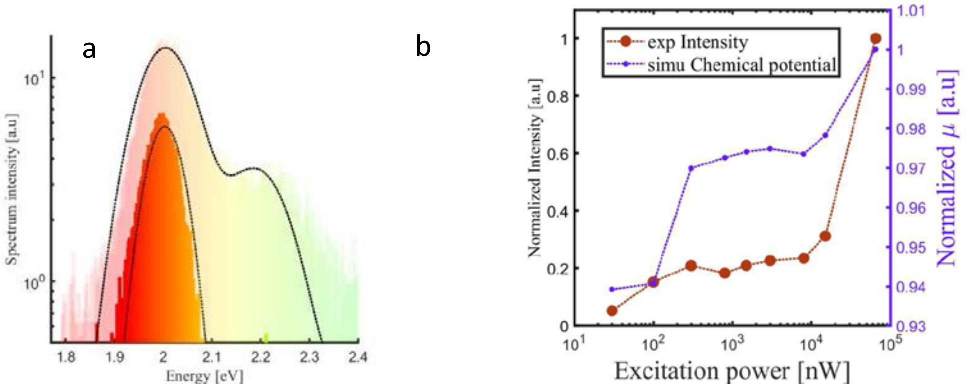

Fig. 1 a) Experimental spectra of a single core/shell CdSe/CdS quantum dot under low and high excitation power. Dashed lines represent the most probable fit. b) Evolutions of the normalized experimental intensity, numerical radiation chemical potential in function of the excitation power.

During the internship the student will consider different types of nano-emitter, quantum dots or quantum wells, and will study their emission under high excitation. He/She will then analyse the experimental datas using among others Bayesian methods, and extent our theoretical model.
During the PhD, in the framework of the ANR CoLIMe, starting in 2024, and in continuity of the internship, we will study strong coupling between multiexcitonic emission of those nanoemitters and plasmonic antennas.

[1] A.R Dhawan, et al. (2020) Light: Science & Applications, 9(1), 1-9
[2] A. R Dhawan et al (2022), Advanced Materials, 34(11), 2108120
[3] P. Wurfel. (1982) 15(18), 3967

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