Minicolloque n° MMPS28

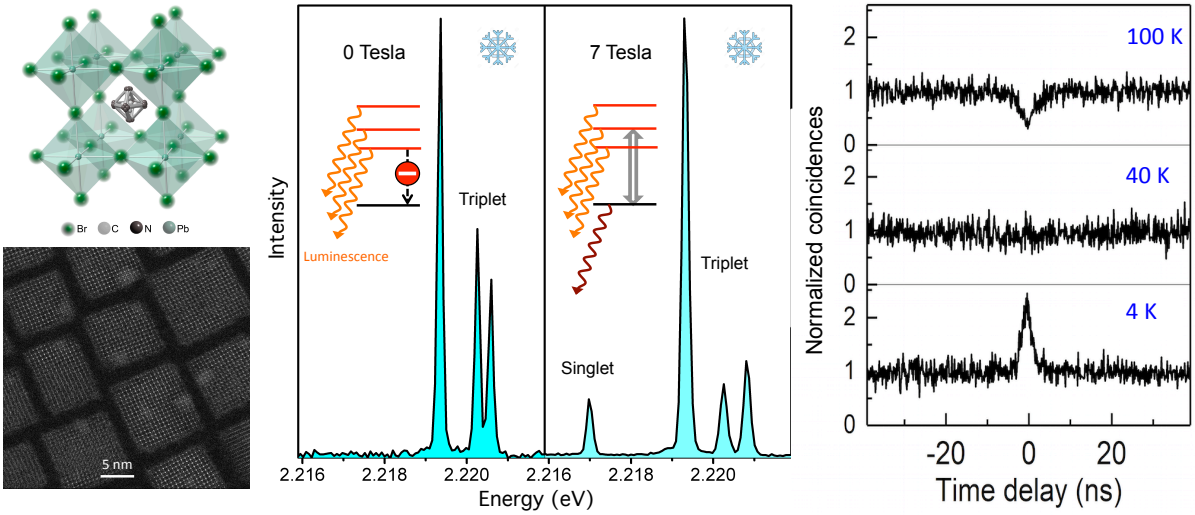
Band-edge exciton fine structure in lead-halide perovskite nanocrystals

Philippe Tamarat

LP2N, Univ. Bordeaux, IOGS &CNRS, Talence (France)

* email : philippe.tamarat@u-bordeaux.fr

Lead-halide perovskite nanocrystals (NCs) have emerged as attractive nano-building blocks for photovoltaics and optoelectronic devices. Optimization of perovskite NC-based devices relies on a better knowledge of the fundamental electronic and optical properties of the band-edge exciton, whose fine structure has long been debated. This talk will give an overview of our recent magneto-optical spectroscopic studies [1-5] revealing the entire excitonic fine structure and relaxation mechanisms in these materials, using a single-NC approach to get rid of the inhomogeneities in the NC morphologies and crystal structures. It will highlight the prominent role of the electron-hole exchange interaction in the order and splitting of the bright triplet and dark singlet exciton sublevels and discuss the effects of size, shape anisotropy and dielectric screening on the fine structure. The spectral and temporal manifestations of the thermal mixing between bright and dark excitons allows extracting the specific nature and strength of the exciton-phonon coupling, which sheds light on the remarkable photovoltaic properties of these materials and provides an explanation for their remarkably bright photoluminescence at low temperature although the ground exciton state is optically inactive. These findings make single perovskite NCs attractive for a potential use as quantum light sources.



[1] M. Fu, P. Tamarat, H. Huang, J. Even, A.L. Rogach, B. Lounis, Nano Letters. 17 (2017) 2895–2901.

[2] M. Fu, P. Tamarat, J.-B. Trebbia, M.I. Bodnarchuk, M.V. Kovalenko, J. Even, et al., Nature Communications. 9 (2018) 3318.

[3] P. Tamarat, M.I. Bodnarchuk, J.-B. Trebbia, R. Erni, M.V. Kovalenko, J. Even, et al., Nat Mater. 18 (2019) 717–724.

[4] P. Tamarat, L. Hou, J.-B. Trebbia, A. Swarnkar, L. Biadala, Y. Louyer, et al., Nature Communications. 11 (2020) 1–8.

[5] L. Hou, P. Tamarat, B. Lounis, Nanomaterials. 11 (2021) 1058.