

# Exciton recombination dynamics in phenylethylammonium based 2D-layered hybrid perovskite monocrystalline thin films.

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## Topic 2 : Fundamental optical processes involving excitons and polaritons

Over the past few years, organic-inorganic halide 3D perovskites were found to present remarkable optoelectronic properties. A great attention has been paid to perovskites thin films, as an ideal building block for PV and LED devices. On the other hand, the study of single crystals has proven necessary to unveil some of the intrinsic properties of these semiconductors [1,2].

The family of organic-inorganic halide perovskites is large and other compounds of this family, such as the 2D ones, have been known for a longer time. Due to their natural quantum well structure and a high exciton dielectric confinement, the 2D organic-inorganic halide 2D perovskites exhibit high oscillator strengths and strong photoluminescence properties, which make them particularly relevant for light-emitting devices. In the past, several works have been done to demonstrate the strong coupling regime at room temperature between excitons and photon modes in vertical microcavities [3,4] or in the distributed feedback geometry [5], or between excitons and plasmons [6]. More recently, 2D perovskites have proved to be interesting also for photovoltaics with efficiencies close to 14 % and a better stability than their 3D counterpart [7]. Nevertheless, many of the fundamental photophysics properties of these 2D perovskites, such as the recombination dynamics of the excitons and the charge separation mechanisms, remain to be understood.

Monocrystalline thin films of phenylethylammonium-based 2D perovskites are produced using the “Anti-solvent Vapor Assisted Capping Crystallization” [7]. A cryogenic micro-photoluminescence study of these samples will be presented (with a sub micrometer precision), allowing to extract the intrinsic properties of the perovskite crystals. In particular, the exciton recombination dynamics will be studied using time-resolved micro-photoluminescence as function of fluence and temperature.

## References:

- [1] D. Shi et al. *Science* **347**, Issue 6221, 519-522 (2015).
- [2] H. Diab et al. *J. Phys. Chem. Lett.*, **7** (24), 5093–5100 (2016)
- [3] A. Bréhier et al, *Appl. Phys. Lett.* **89**, 171110 (2006)
- [4] H. S. Nguyen et al, *Appl. Phys. Lett.* **104**, 081103 (2014).
- [5] T. Fujita et al, *Phys. Rev.* **B57**, 12428 (1998).
- [6] C. Symonds et al, *New J. Phys.* **10** (2008) 065017
- [7] H. Tsai, *Nature*, Volume **536**, Issue 7616, 312-316 (2016).
- [8] F. Lédée et al, *Cryst. Eng. Comm.* **19**, 2598 – 2602(2017).

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