Unravelling the Exciton Fine Structure in Two-Dimensional Lead-Halide Perovskites

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Two-dimensional (2D) hybrid lead-halide perovskites emerged in recent years as an interesting alternative for optoelectronic and photovoltaic applications. Due to the both quantum and dielectric confinement, exciton binding energy in these materials is greatly enhanced and can reach up to few hundreds of milielectronvolts [1]. This makes 2D perovskites attractive objects for the investigation of exciton physics, since all excitonic effects are greatly enhanced in this system. It also results in the significant splitting of states within the exciton fine structure, which can have a dramatic impact on the performance of light emitters or other devices based on these 2D materials [2].

Using the polarisation-resolved optical spectroscopy techniques combined with magnetic field, we investigate the exciton fine structure of series of perovskite compounds with increasing number of octahedra layers n within a slab, *i.e.* increasing width of the quantum well. For the compound with n=1 we revealed the full exciton fine structure, including the dark state [3]. Further magnetooptical studies [4] on the perovskite compounds with n=2, 3 and 4 shown the evolution of the energy of the bright *in plane* states with respect to the magnetic field (Fig.1), which allowed us to extract the values of the bright exciton g factors, as well as the values of the diamagnetic shift with respect to the number of inorganic layers. Obtained results provide valuable information about the evolution of optoelectronic properties of 2D perovskites with increasing thickness of the quantum well.

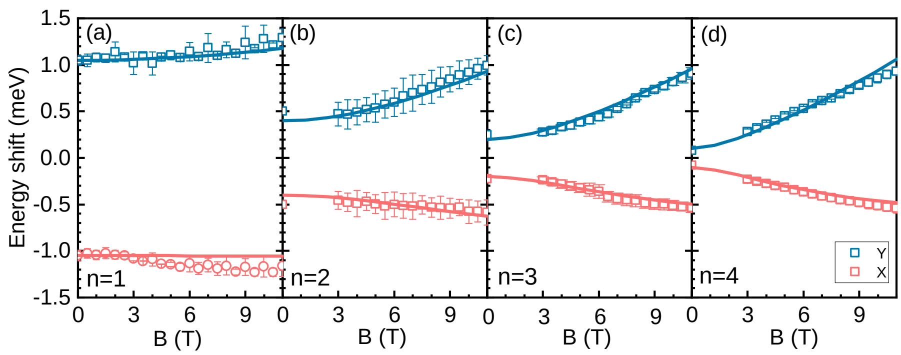

Figure 1: Energy of the bright excitonic *in plane* states with respect to the magnetic field.

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[2] P. Tamarat *et al.*, *Nature Materials* **18**, 7, 717–724, (2019).
[3] K. Posmyk *et al.*, *J. Phys. Chem. Lett.* **13**, 20, 4463-4469 (2022).
[4] K. Posmyk *et al.*, *J. Am. Chem. Soc.* **146**, 7, 4687–4694 (2024).