Organic and inorganic metal halide perovskites (from now on simply called perovskites) constitute a particular semiconducting materials system, in some aspects very different from the well-known and understood family of epitaxial semiconductors. They have emerged as revolutionary semiconductor materials for energy harvesting application. The solar cells applications rely mostly on the bulk (3D) form of perovskites. However, the huge interest in 3D perovskites has also triggered an investigation of their lower dimensional forms, such as nanocrystals and two-dimensional (2D) perovskites. The latter can be considered as a natural quantum well consisting of octahedral slabs separated by large organic spacers. They exhibit extremely enhanced excitonic effects due to the dielectric confinement and reduced screening. Both groups, 2D perovskites and nanocrystals, are known for their superior emissive properties. Their quantum emission efficiency is one or two orders of magnitude higher than in epitaxial inorganic semiconductors. The microscopic origin of this technologically important characteristic is still the subject of ongoing research and has been controversially discussed in literature.

During recent years it has been proposed that this superior light emission efficiency can be (surprisingly) related to the mechanical properties of perovskites. The softness of perovskites (including their bulk and lower dimensional forms) is one of the most striking features, which distinguish them from epitaxial semiconductors. The bulk moduli characterizing 3D and 2D perovskites is around ten times lower than the one describing silicon or gallium arsenide. These mechanical properties of perovskites seem to have a dramatic impact on their electronic and optical properties standing behind their grate efficiency in light emitting devices.

In this project, we investigate the microscopic origin of the great light emission efficiency of 2D perovskites. These technologically promising nanomaterials constitute an unprecedented playground to study the study synergy between mechanical and optical properties in semicondcutors.