Because of discrete energy levels, a single quantum dot is similar to a single atom. The wide scope of quantum dot manufacturing techniques of as well as relatively easy manipulation of their properties (and therefore manipulation of energy levels) is responsible for calling them “artificial atoms”. The same ease of manipulation gives hope for future applications of quantum dots. Moreover, quantum dots are perfect examples of simple model systems where fundamental physics can be studied. Especially appealing objects of research are single quantum dots with single magnetic ions which allows lattice-ion, and ion-carriers interaction studies.

However from an experimental point of view studies of single quantum dots (which size is in range of nanometers) demand some kind of microscope. The most common experimental setups used for spectroscopy of single quantum dots are: an objective microscope outside the cryostat or a small lens or microscope objective on piezo-positioner in the cryostat. Both of these approaches have crucial disadvantages (e.g. lack of mechanical stability, additional space needed in experimental setup etc.) which limits the scope of experimental techniques that can be used. With optical microstructures proposed in this project, printed in ultrahigh resolution 3D printer, neither outer microscope objective is needed nor small lens on positioner in cryostat for single spectroscopic quantum dots measurements.

Moreover, proposed approach gives possibility of multiple measurements of the same quantum dot which dramatically reduces measurement time and allows to reuse of measured data in further research with the same quantum dot. Samples with single quantum dots with proposed optical microstructures can be transported to other laboratories which are not equipped with specialized microscopic setups. Additionally such a quantum dot record will help in planning advanced experiments based on previously gathered data.

As a demonstration we will study coupled CdTe quantum dots with single Co^{2+} ion. Measurements of such rarely occurring systems with standard μPL setup were thought to be so time-consuming that it has never been attempted. However application of the optical microstructures proposed in this research project would enable the efficient investigation of coupled CdTe quantum dots with single Co^{2+} ion. We will study such a pair in context of interaction between Co^{2+} ion and carriers present in quantum dot.