

In the last years we can constantly observe increasing interest in non-classical quantum light source i.e. such emitters which are able to emit only one photon per excitation cycle or are able to emit so called pair of entangled photons. This interest is driven by the needs of secure communication protocols and metrology. So far many sources of single photons has been demonstrated where the most interesting for real life application are these based on solid states. This is because the solid states solutions can be relatively easy integrates with existing electronic and can be grown with well-developed technology. Nevertheless there are still some problems that need to be overcome. In most of such solutions atom-like emitters, including fluorescent atomic defects or quantum dots, are buried in a bulk solid state matrix which significantly hinder efficient extraction of photons. Usually single photon emitter emits photon in random direction. Due to the total internal reflection phenomena at matrix-air interface only small part of photons leave the solid matrix. Another challenge is related to random distribution of single photon emitters in solid matrix which hinders scalability of the final device production.

In this project we want to address these two problems with the use of 2D semiconductor namely monolayers of transition metal dichalcogenides. These van der Waals crystals, which are stable even in monolayer form, in the last few year have been under great interest of scientist originating from the set of unique properties of this materials which seems to be extremely attractive for practical realization of valleytronics and spintronic concepts.

In addition to all fascinating properties of transition metal dichalcogenide, they can be used as nonclassical photon source. It was discovered that particular defects in this materials behave as a single photon emitters. Because this materials are 2D the problem of photon extraction is absent. Moreover this kind of defect can be deterministically created in given part of the flake by local strain control. This can be realized by the deposition of transition metal dichalcogenides flakes on patterned substrate.

In this project we want to explore this fascinating way of single photon emitters creation. We want to merge well established technology of III-V semiconductor nanostructures with transition metal dichalcogenides monolayers for site and properties control of single photon emitters. We expect tunability of the optical properties by varying the shape or material of the underlying nanostructures. Such hybrid structure may enable new routes towards scalable production of efficient single photon emitters. However to achieve this deep understanding of III-V/transition metal dichalcogenied heterostructure physics is needed which is the general objective of this project.