

**B.Sc. (including Fagprojekter) or M.Sc. project**

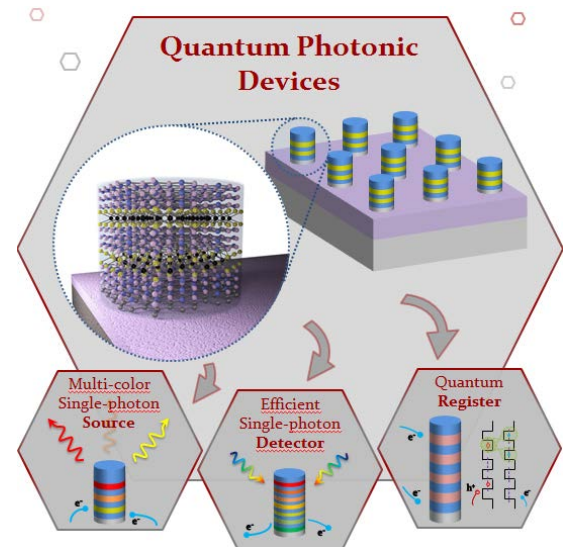
*the level of the project can be adapted to the study program*



## Quantum Photonic Devices with Ultimate Design Precision

*This project in collaboration with DTU Fotonik and Nanotech aims at the realization of a new platform based on 2D nanostructures for the making of novel atomically precise devices for quantum technologies.*

Quantum Photonic Devices are one of the major parts of quantum technologies and are expected to have a huge impact on the future applications of the quantum realm. For example, quantum registers, one of the bases for the future quantum Internet, could be built with a set of precisely engineered quantum photonic structures, very close to each other. One of the most promising types of such structures is semiconductor quantum dots. Those are small objects that emit single particles of light (photons) with colors that can be defined by varying the dimensions of the emitter. However, the entire field is now limited by how precisely we can define such dimensions, because of fabrication limitations. For instance, we cannot make two dots which are exactly same or different by design and this does not allow us to make the multi-quantum dot structure necessary to build e.g. a quantum register. A new technique with very high precision in the fabrication of these structures would be a breakthrough with huge potential, both in the studying of fundamental properties and on the making of novel devices, such as multi-color single photon sources, detectors and even more complex structures like quantum registers. Here we propose a novel platform based on 2D materials that will allow the fabrication of atomically precise multi-quantum dots structures. Exfoliation of single layers will allow for stacking of different 2D material, atomic layer by atomic layer, which means potentially reaching the absolute precision of fabrication. The students will have the unique possibility to use recent theoretical predictions about new 2D materials and novel stacking techniques (Nanotech expertise) to create a very flexible platform optimized for quantum photonics applications (Fotonik expertise) and get the best of the two departments! We are thus looking for motivated students that want to learn how to stack 2D materials and create such kind of nanostructures and also are excited to take part in the characterization of the sources in our newly built quantum optics laboratory.



**Goals of the project:** Stack 2D materials to obtain the desired quantum structures. Test and optimize the process using different techniques and different 2D materials. Test the fabricated devices and characterize their quality and potential for quantum technologies.

**Skills/knowledge acquired through the project:** 2D materials, stacking and fabrication techniques, single photon sources, theory and experimental implementation and characterization; applications in Quantum Communication.

**Background:** Knowledge of quantum mechanics is advantageous for the student.

### Supervisors:

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