Master project

The development of optically-active gate-defined quantum dot

Background

This project is motivated by realizing a quantum network consisting of multiple "quantum nodes" entangled via "quantum channels". Such network (see example in Figure 1) could become the basis of quantum Internet or quantum communication system. The aim of this project is to develop a new type of optically-active gate-defined quantum dot acting as an interference between flying photonic qubits and stationary spin qubits.

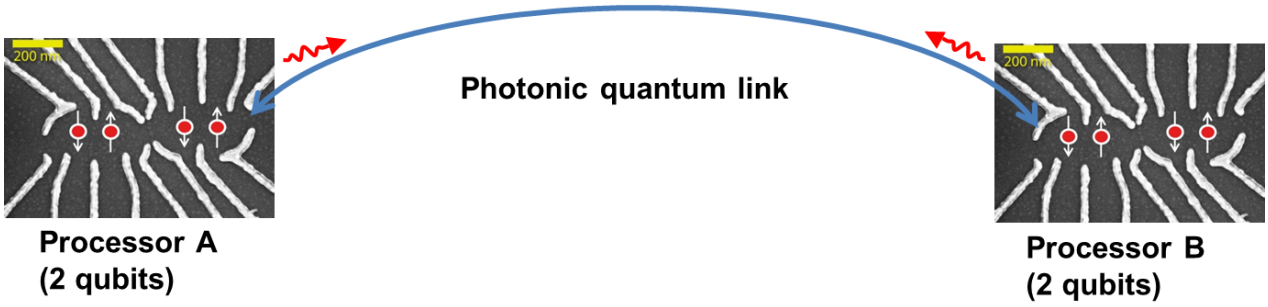

Figure 1. Proof of principle quantum network based on semiconductor spin qubits. This minimal quantum network consists of two quantum processors (quantum nodes) with two spin qubits. The two quantum processors can be entangled by converting the spin qubits to photonic qubits and performing quantum interference between the photonic qubits from the two processors.

Your task

The master student will be involved in building a 4 K optical setup and conduct a systematic characterization of the optically-active gate-defined quantum dot (see example in Figure 2) by performing quantum optical/transport experiments at cryogenic temperature (4.2 K). This project also involves in programming in Python. The successful completion of this project will provide the student a strong basis for his/her future PhD project. Depending on the start date, the student may have the opportunity to conduct experiments both in Forschungszentrum Jülich and RWTH Aachen.

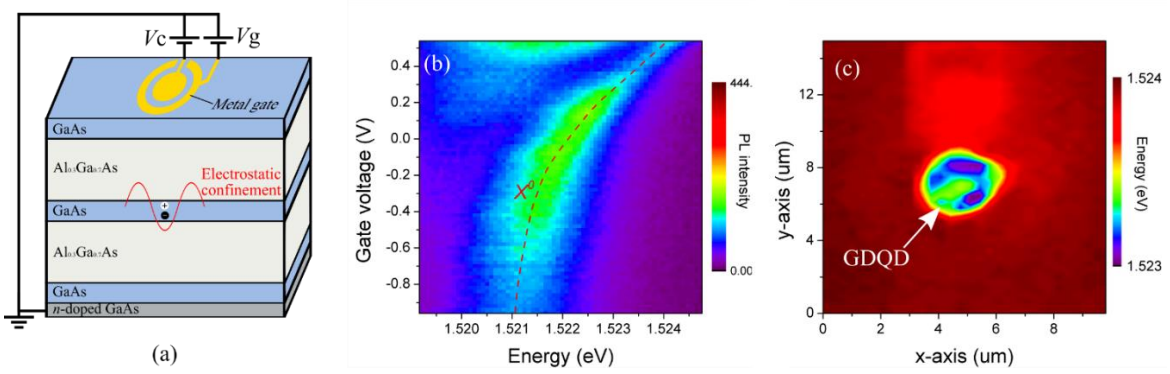

Figure 2. (a) Schematic of the optically-active GDQD. (b) Stark shift of the neutral exciton X^0. (c) Spatial PL map measured at Vc = -2.3 V. The color scale corresponds to the energy of the PL peak. A clear red-shift of the PL peak is observed at the position of the metal gates, indicating a lateral electrostatic confinement could be formed. T= 12 K.

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