Masters Student Projects:
GaAs Spin Qubits
at the Center for Quantum Devices

Electron spins in gallium arsenide heterostructures are an attractive platform to study quantum systems consisting of more than one or two qubits. Our spin qubit team is looking for masters students interested in studying electron spins in these quantum dots to build a quantum processor or to study fundamental spin physics.

An example of a recent device comprises four double quantum dots (pairs of small circles in image below), each operated as a singlet-triplet spin qubit. These are coupled together into a four-qubit cluster via a multielectron dot (long oval in image), which serves as a coherent coupler.

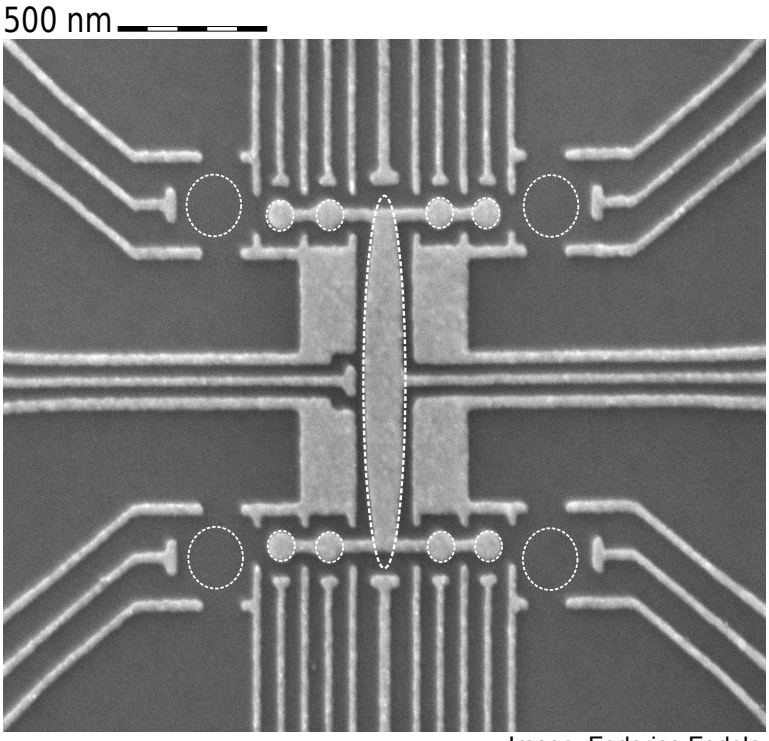

Image: Federico Fedele

By cooling this device to a temperature close to the absolute zero (20 mK) and applying high frequency pulses (MHz to GHz), we are able to isolate single electrons in these quantum dots, control and read out their spin state with high fidelity, and accurately watch their intricate spin dynamics. The possibility to couple more than two qubits opens up exciting possibilities, but there are challenges to be solved. Possible projects addressing some of these challenges include:

- Simultaneous measurement of all four qubit states via a multiplexed system based on high-frequency electronics.
- The development of automatic tuning procedures and the implementation of cross compensation techniques in the control software.
- Simulation tools for high-dimensional charge stability diagrams.

If you are interested in these or other projects of the spin qubit team, please contact Ferdinand Kuemmeth (kuemmeth@nbi.dk).