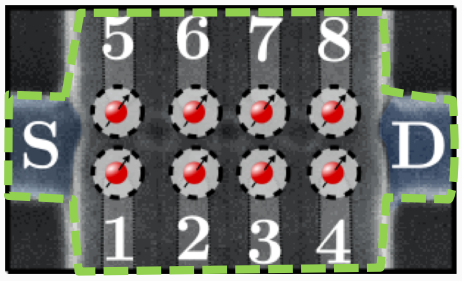
NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2021-2022

Realization of a two-Qbit logic gate in silicon

General scope:

Quantum computing is a field of growing interest, especially in Grenoble with an exceptional concentration of both research and industrial groups active in this field. The global aim is to develop a new kind of nano-processor, based on quantum properties. Its building brick is a two-level quantum system (the qubit), in our case the spin of an electron trapped in a quantum dot. In this context, the Grenoble Quantum Silicon Group is actively trying to leverage the decades of development of the Silicon industry in Grenoble to realize a network of inter-connected semiconductor spin qubits.



An array of CMOS spin qubit

Research topic and facilities available:

The goal of the project is to design and measure silicon architectures to perform basic quantum operations. More precisely, we will investigate how to measure the spin state of quantum dots in small arrays and how to implement logic gates. During the internship we will focus on the realisation of single shot readout of a qubit and single and two qubit gates.

The quantum system will be designed in order to be compatible with large scale integration. All the samples will be fabricated at CEA-LETI with a state-of-the-art Si facility to enable maximum output and reproducibility. To control and manipulate the electron spin coherently, the applicant will benefit from the long-standing expertise of the Neel-group in AlGaAs based electron spin qubits (computer control, low temperature cryogenics, low-noise electronics, Radiofrequency electronics).

[1] *Charge Detection in an Array of CMOS Quantum Dots*. E. Chanrion et al, Phys. Rev. Appl 2021.
[2] *Coherent control of individual electron spins in a 2D quantum dot array*. P-A Mortemousque et al, Nature Nanotechnology 2020.

Possible collaboration and networking:

This project is co-lead by the CEA-Leti and the CNRS-Néel Institute via the "Quantum Grenoble Silicon" group. The circuit is conceived and fabricated by the CEA-Leti, and measured at the Néel Institute. Therefore, the candidate will have strong interactions with other actors of the QSG project and benefit from their developments.

Required skills: We are looking for a motivated student, with an interest for experimental physics. This internship requires skills in electronics, programming, and a good understanding of quantum physics. A knowledge of cryogenics or quantum circuit will be appreciated but is not mandatory. An interest to continue as a PhD student is a plus.

Possible extension as a PhD: Yes, with funding already secured.
Starting date / Duration: Flexible
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