NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2022-2023

Electrical characterization of CMOS-based Si spin qubits.

General Scope :

As part of the Quantum Silicon Grenoble project, teams at Néel Institute, CEA-LETI and CEA-IRIG aim at building a quantum accelerator with silicon spin quantum bits (qubits). Compatible with large-scale production, existing integration processes on Si are a real advantage for the scalability of these qubits (see Fig.1). However, the reproducibility of charge and spin characteristics of these devices are yet to be explored and improved. This requires extensive/statistical electrical characterization and continuous feedback to process integration team.

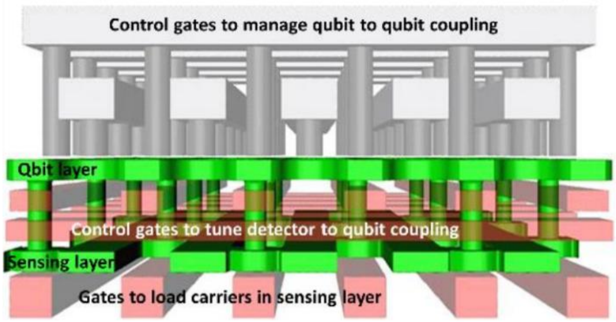

Figure 1- Example of scalable integration of multi-qubits proposed by the Quantum Silicon Grenoble (credit: M. Vinet).

Research topic and facilities available:

Urgent needs on information of variability and reproducibility of spin qubits characteristics rise as fast as the need of integrating a large number of qubits on chip. With the popularization of new low temperature characterization tools (such as cryogenic probe stations and multiplexed matrices) to extract statistical information on the qubit and understand more deeply their properties, the development of measurement procedures, automation and efficient analysis methodologies appear as important tasks. The candidate will work on such tasks, in particular, to help our team to improve our actual knowledge on the reproducibility of charge and spin characteristics of FDSOI CMOS-based qubits. She/he will study different devices architectures and evaluate their performance, providing understanding on the associated physical effects. For this, the candidate will have the opportunity to use the low noise and ultra-low temperature electrical measurement techniques available in the spin qubit team.

Possible collaboration and networking:

This work is part of a large collaborative effort to develop and push the technology of spin qubit in silicon and investigate its potential scalability. The candidate will work in a consortium made of Néel Institute, CEA-LETI and CEA-IRIG researchers, at the interface between the characterization and the integration teams.

Required skills:

We are looking for a motivated student, with a background in microelectronics and/or condensed matter physics. It is essential to have good knowledge of semiconductors physics, in particular of the CMOS technology. Good Python skills, as well as good written and spoken English skills are required, on the same way as communication, ability of writing reports and team work.

Possible extension as a PhD : Yes

Starting date: in between January and April 2023

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