Investigation of single spin qubits fabricated with industrial processes as a resource for quantum application with hybrid quantum circuits

Thesis supervisors:
- Academia: Prof. Eva Dupont-Ferrier, Institut quantique, Université de Sherbrooke (UdS), Québec Canada & Prof. Salvador Mir, UGA TIMA France (*co-tutelle*)
- Industry: Dr. Philippe Galy, STMicroelectronics, Crolles, France

External collaborator:
Dr. Félix Beaudoin, Nanoacademic Technologies, Montréal, Québec, Canada

Location: The PhD will be carried between STMicroelectronics, UdS and TIMA (France-Canada)

Funding: Research contract with STMicroelectronics in the framework of the French program *Conventions Industrielles de Formation par la Recherche* (CIFRE) in *Cotutelle* with the Université de Sherbrooke. Net salary is around 2000 Euro/month

Starting date: The position is available now.

Duration: 3 years

Context: Spin qubits are a promising candidate for quantum computation because of their compatibility with industrial fabrication processes, and their long coherence and relaxation times. Consequently, spin qubits could be used as an advantageous resource for alternative quantum computing approaches based, e.g., on superconducting circuits.

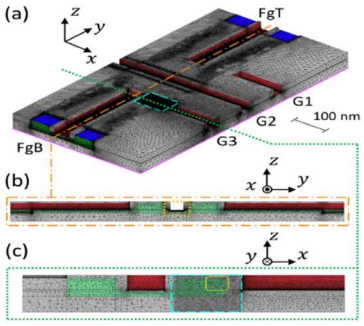
Project description: Industrially fabricated devices based on the fully-depleted silicon-on-insulator (FDSOI) technology have been shown to be excellent candidates for cryogenic temperature operation (<100mK). Building on our previous studies and on our latest results (see Refs. [1,2], and Figure 1), the goal of this PhD is to realize a deeper investigation of the technological and topological parameters which impact the performance of the spin-qubit structure implementing a physical qubit. More specifically, the idea is to propose innovative structure(s) or process step optimizations to implement hybrid FDSOI solution(s). Numerical simulations with the quantum modelling tool QTCAD (in partnership with Nanoacademic Technologies Inc.) will allow to quantitatively evaluate the trends, to improve the initial structure, and establish best candidate designs, culminating with their integration in FDSOI technology.

Skills:
A candidate with an engineering background should have a master's degree in silicon physics and simulations in a technology computer-aided design (TCAD) framework, e.g., Cadence, Synopsys, Silvaco, COMSOL. A candidate with a quantum physics background should have a master's degree in modelling of quantum or nanoelectronic devices.

Contact:
Candidates are invited to send a brief motivation letter, a CV, and full university transcripts to Philippe Galy at philippe.galy@st.com.

References:

1. Kriekouki *et al*. Solid State Electronics 194, 108355 (2022). URL: https://www.sciencedirect.com/science/article/abs/pii/S0038110122001277
2. Beaudoin *et al*. Applied Physics Letters 120, 264001 (2022). URL : https://aip.scitation.org/doi/10.1063/5.0097202 https://iopscience.iop.org/article/10.1088/0957-4484/27/46/464003



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