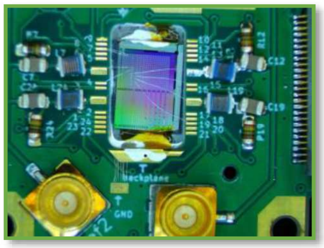
Master thesis Project

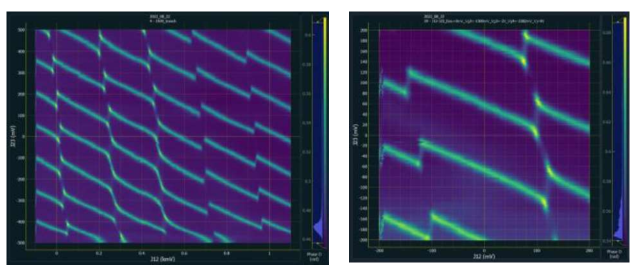
Radio-Frequency Reflectometry for Si spin quantum bits



Si chip bonded for RF measurements

Our group is working on silicon and germanium spin quantum bits. Recently we have demonstrated state-of-the-art performances for a hole spin quantum bit made with silicon-on-insulator CMOS technology, in collaboration with CEA-LETI [1]. We are also developing germanium based devices which are alternative promising candidates for a scalable quantum computing platform.

During this master thesis project you will measure down to very low temperatures (below 4.2K) a new series of devices which feature very narrow channels, down to 25nm. Four P-type wafers have been processed with 2 different types of oxide and 2 different materials for the gate stack. These various flavors should allow to clarify the location where the first holes appear at very low temperature. Indeed we have inferred from previous studies and strong collaborations with a theory group at IRIG that the presence of TiN at the bottom of the gate stack favors the appearance of the first holes on the sides of the top gate and not right underneath, as expected. The availability of an alternative oxide from the usual thermal oxide shall also help as it changes the rounding of the nanowire, resulting in a different confinement potential. This experimental work will rely heavily on using (and improving) the reflectometry technique. With this scheme, we probe the resonance frequency in the 100s of MHz of the sample embedded in a tank circuit. This RF measurement is much more powerful than recording the drain-source current, especially below or near the threshold, which is the region of interest for the first carriers. The figure on the right shows an example of such measurements, highlighting the coupling regimes of two coupled quantum dots.



RF signature of different coupling regimes for 2 quantum dots, obtained at 400mK by varying the gate voltages driving each dot.

The candidates should have a solid background in solid state physics and a taste for instrumentation. This project is a good start for a PhD in our laboratory in the field of spin qubits.

[1] Piot *et al.*, https://arxiv.org/abs/2201.08637 (accepted for publication in Nature Nanotechnology)

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To apply for this position, send your application (including CV) by e-mail to: xavier.jehl@cea.fr

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