Institut de Recherche Interdisciplinaire de Grenoble

Master Project

Hybrid Superconductor – Semiconductor nanostructures

Hybrid Superconductor – Semiconductor (S-Sm) nanostructures are nano-circuits which combine superconducting and semiconducting materials. Such devices take advantage, first from the superconductivity that is a macroscopic quantum effect and can be viewed here as a quantum coherence provider or injector. Second, from the semiconducting properties that allow changing the amount of carriers using an electrostatic gate – like in a field effect transistor (FET). New electronic properties and functionalities can appear from this unique combination which are revealed at very low temperature (typically below 1 K). The underlying mechanism that makes these nanostructures so appealing, is the proximity effect which describes how quantum coherence in the superconductor can leak into the semiconducting material and therefore strongly modify its electronic properties [1]. For example Al-Ge-Al based nanodevices with short Ge channel (~ few hundreds of nm) can exhibit a zero resistance state that can be controlled by a gate [2]. These devices have recently attracted a new interest with the possibility to realize reproducible high transparent S-Sm interface. Their potential for quantum technologies has been demonstrated with the realization of new types of superconducting qubits [3]
During this internship, the student will perform measurements at very low temperature of existing devices made from Si or Ge transistors with superconducting source and drain contacts. The objective is to characterize the S-Sm properties for the realization of more complex devices. He/She will acquire the experimental techniques related to electronic properties at very low temperature (T < 100 mK) and the physics of S-Sm interface. She/he will join the LaTEQS team (www.lateqs.fr) with 30 people including 15 PhD students and post-docs. The internship will take place at the CEA-Grenoble in the Minatec campus.

[1] Klapwijk, T.M.*J Supercond* **17**, 593–611 (2004)
[2] Vigneau et al. Nano Letters, **19**, 1023 (2019)
[3] Casparis et al. Nature Nano. **13**, 915 (2018)

SQUID geometry with two Al-Ge-Al superconducting transistors in a loop.

APPLY NOW!

To apply for this position, send your application (including CV) by e-mail to:
francois.lefloch@cea.fr or silvano.defranceschi@cea.fr

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