MASTER PHYSIQUE ET APPLICATIONS
2ème année
Master Dispositifs Quantiques

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Internship offer

Laboratory: Centre de Nanosciences et de Nanotechnologies (C2N - UMR 9001), Université Paris-Saclay

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Many-body quantum simulation with electrical circuits

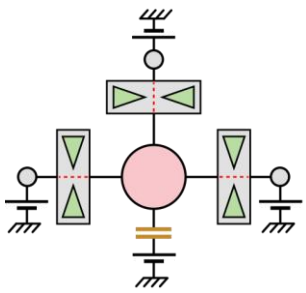
Scientific project: The objective of this internship/PhD is to explore a broad range of many-body physics using nanoelectronic circuits as quantum simulators.

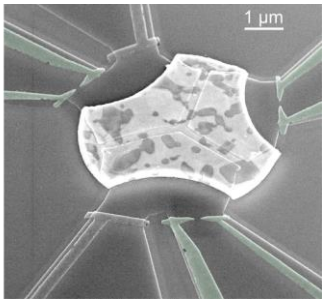
Whereas conventional materials can be described within a free electron theory, many-body interactions are at the root of unconventional properties, including with a high application potential such as high temperature superconductivity. However, a quantitative understanding of the underlying microscopic mechanisms is still lacking experimentally and theoretically due to the many-body complexity. Experimental quantum simulation can provide a powerful workaround to these experimental and theoretical barriers.

The project is to implement quantum simulators for the experimental exploration and theoretical understanding of the strongly correlated physics with direct implications for the quantum engineering of nanoelectronic circuits. A particular emphasis will be put on the so-called quantum criticality developping in the vicinity of quantum phase transitions.

For this purpose, the PhD work will be to design, realize and characterize new quantum simulators based on solid-state circuits composed of several elementary quantum constituents (quantum point contacts, quantum dots, small metallic nodes). This work will build on the team's recent quantum simulation of the Luttinger liquids describing 1D conductors [Phys. Rev. X **8**, 031075 (2018)], of the charge quantization in quantum circuits [Nature **536**, 58 (2016)] and of the exotic physics connected with Kondo-type models [Nature **526**, 233 (2015), Science **360**, 1315 (2018)].

The work ranges from ultra-sensitive measurements (electrical conductance and fluctuations, thermal properties) at extremely low temperature, in a dilution refrigerator, to e-beam nanolithography using the outstanding C2N facilities. The student will be involved in all aspects of the project, including the theoretical work of analysis and modelling.





Methods and techniques: Experimental work (nanofabrication in clean room; sensitive measurements at very low temperature including electrical fluctuations and thermal properties) in close collaboration with theorists

Possibility to go on with a PhD ? Yes

Envisaged fellowship ? ANR funding available