MASTER INTERNSHIP - 2018

Development of a simulation software of superconducting electronics based on the use of Josephson junctions at terahertz frequencies

The Laboratory of Microwave and Characterization (IMEP-LAHC, CNRS UMR 5130) of Université Savoie Mont Blanc located in the French Alps area develops ultrafast energy-efficient superconducting digital circuits that work with clock frequencies of several tens of GHz, based on the Rapid Single-Flux Quantum (RSFQ) technology. Such circuits use a binary dynamic logic derived from the underlying physics of shunted Josephson junctions in free-running mode. In present of forced oscillations the strong non-linearity of Josephson junctions leads to the generation of harmonics or frequency mixing depending on the input signals. These effects are used for instance in radioastronomy and has enabled the development of quantum-sensitive terahertz (THz) receivers, used at the focal point of ground-, balloon- and space-based telescopes.

The objective of this internship is to go one step further and develop new kinds of devices for usage in several additional domains, like security, medicine or telecommunications systems. That is possible by combining analogue and digital devices to build all-superconducting mixed-signal systems. Such developments can also be interesting for the readout of quantum-accurate imagers, magnetometers or quantum computing systems.

To do so we need to develop user-friendly softwares that can enable the simulation of systems based on Josephson junctions. For this particular subject, the work will be focused on the analogue mode of operation of Josephson junctions in the THz domain. The objective of the work is to build a user-friendly software programmed in C/C++ or Python for instance and that can be compiled to run on different operating systems (at least Linux and MacOSX). The student will benefit at the beginning of a dedicated education to deal with the detailed physics of Josephson junctions. Some preliminary kernel codes, written in Fortran, already exist. The full formalism of equations to be used is also ready.

An education in physics and computer science is best suited to achieve the objectives of this subject.

Education: Engineering school or master level students

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Internship duration: 4 to 6 months during the 2018-2019 school-year

Accommodation : Student's rooms are available on campus for a monthly rent of about 200 euros.
https://www.crous-grenoble.fr/wp-content/uploads/sites/7/2017/06/GuidesResidenceCLOUS-WEB.pdf
This internship comes with a stipend of 554.40 € per month.