Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition : 25/11/2015

Responsable du stage */ internship supervisor*:

Nom / *name*: BERTET Prénom/ *first name* : Patrice

Tél : 01 69 08 55 29 Fax : 0169087442

Courriel */ mail*:
Patrice.bertet@cea.fr

Nom du Laboratoire / *laboratory name*: Quantronics group

Code d'identification : Organisme : CEA, CNRS, Université Paris-Saclay

Site Internet / *web site*: http://iramis.cea.fr/drecam/spec/Pres/Quantro/static/

Adresse / *address:* SPEC (Service de Physique de l'Etat Condensé), CEA Saclay, 91191 Gif-sur-Yvette

Lieu du stage / *internship place*: idem

Titre du stage / *internship title*:
Towards Coupling a Superconducting Qubit to a Single Spin

Résumé / *summary*

Quantum Information aims at realizing a new type of computer, based on registers of two-level systems (the qu-bits) whose quantum state can be manipulated according to precise algorithms in order to solve problems otherwise untractable by classical machines, thanks to the massive parallelism offered by the quantum-mechanical superposition principle.

Spins in solids are ideal candidates for implementing such a quantum computer, because they are natural two-level systems with a very long coherence time (that can reach one second, or even one hour in certain cases) when embedded in a very pure crystalline matrix. The biggest challenge, unsolved for now on, is to couple several of these spin qubits in order to realize non-trivial quantum logic operations. In the framework of an ERC project, we are exploring an ambitious idea, which consists in coupling each spin to a superconducting circuit that would then mediate the interaction between distant spins. The first step consists in **coupling one superconducting circuit called the "flux-qubit" to a single spin**, implemented by a NV center in diamond. For that the flux-qubit circuit will be fabricated directly on top of an ultra-pure diamond crystal, made out of isotopically-enriched Carbon 12 material, in which a NV center has been located with nanometric precision.

Experimental techniques : clean-room techniques (optical and e-beam lithography, fabrication of tunnel junctions, all available in-house), optical detection and characterization of individual NV centers (confocal microscope), low-temperature cryogenics (20mK), ultra-low-noise microwave measurements

The student will work under the supervision of a postdoc, in addition to the permanent scientist in charge. This internship can be followed by a PhD, on the same subject

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : yes**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: CFR (CEA) or EDPIF**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**