

Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage

Date de la proposition : 01/03/2015 – 30/06/2015

Responsable du stage / internship supervisor:			
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Code d'identification : UMR 5221		Organisme : Université de Montpellier and CNRS	
Site Internet / web site: http://www.coulomb.univ-montp2.fr			
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Lieu du stage / internship place: Montpellier			

Spin Qubits in wide-bandgap semiconductors

Electronic spins associated with point-like defects in wide-bandgap materials are at the heart of a broad range of emerging applications, from quantum information science, to the development of highly sensitive quantum sensors. In that context, the nitrogen-vacancy (NV) defect in diamond has attracted considerable interest because its electronic spin can be polarized, coherently manipulated, and readout by pure optical means with long coherence times, even under ambient conditions. In the last years, these exceptional quantum properties have been exploited to realize elaborate quantum protocols [1] and to develop highly sensitive magnetic field sensors [2].

The objective of the PhD project is to identify new defects in other wide-bandgap semiconductors, which would offer an expanded range of functionalities compared to NV defects in diamond. We will focus on the optical and spin properties of defects in silicon carbide (SiC) [3] and boron nitride (BN) crystals, both at room temperature and under cryogenic conditions. We will analyze (i) how these new defects could be used for quantum sensing applications at the nanoscale and (ii) the efficiency of the spin/photon interface at low temperature in order to realize spin/photon entanglement protocols, which is a key ingredient for long distance quantum communications.

[1] See for example, W. Pfaff *et al.*, *Science* **345**, 532 (2014).

[2] L. Rondin, J.-P. Tetienne, T. Hingant, J.-F. Roch, P. Maletinsky, and V. Jacques, *Rep. Prog. Phys.* **77**, 056503 (2014).

[3] W. F. Koehl *et al.*, *Nature* **479**, 84 (2011).

Recent publications of the host group

J.-P. Tetienne *et al.*, *Science* **6**, 6733 (2014)

A. Dréau *et al.*, *Phys. Rev. Lett.* **113**, 137601 (2014).

A. Dréau *et al.*, *Phys. Rev. Lett.* **110**, 060502 (2013)

Website : <https://sites.google.com/site/quantumspinsensors/home>

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: YES