Master 2: ***International Centre for Fundamental Physics***

INTERNSHIP PROPOSAL

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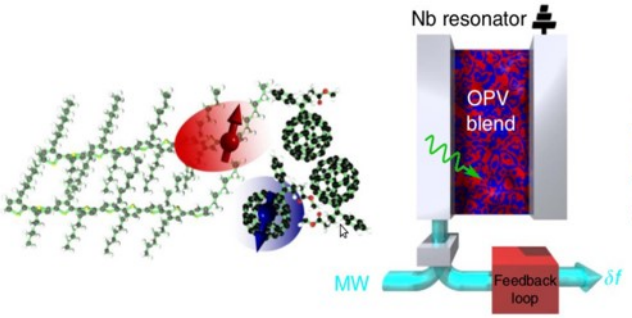
Thesis possibility after internship: **YES** / ~~NO~~
Funding: **YES** / ~~NO~~ If YES, which type of funding: **ANR**

Spintronics of excited states in novel photovoltaic materials

Harvesting of photo-excitations in organic solar-cells is fundamentally governed by the quantum mechanical property of spin. Indeed, spin determines the generation and recombination pathways for a particular species, which ultimately determines device performance. Crucial to solar cell operation are spin-triplet excitons, which have the potential to overcome conventional efficiency limits through the singlet fission mechanism in which twotriplet excitons can be generated from a single singlet exciton. The unique spin signatures of triplet excitons makes them ideally suited for investigations using spin-resonance techniques. We propose to study the interaction between spin dynamics and transport properties using a novel technique where triplet excitons are coupled to a microwave superconducting resonator which can simultaneously probe transport and spin-resonance signals (see sketch below). By performing these measurements at sub-Kelvin temperatures, we aim to unravel the quantum mechanical processes giving rise to singlet fission. Finally successful energy transfer of triplet excitons created through singlet fission into perovskites based photovoltaic materials has recently been demonstrated. We will thus study this process in the limit of few atomic layer thick pervoskites single crystals.



Simplified schematic of the experimental set-up used to detect spin-dependent recombination through the dielectric polarizability.

[1] Sam L. Bayliss, Karl J. Thorley, John E. Anthony, Helene Bouchiat, Neil C. Greenham, and Alexei D. Chepelianskii, Physical Review Letters, 92, 115432 (2015)
[2] Sam L. Bayliss, Neil C. Greenham, Richard H. Friend, Helene Bouchiat and Alexei D. Chepelianskii, Nature Communications 6,8534 (2015) DOI: 10.1038/ncomms9534
[3] Sangsu Lee, Daesub Hwang, Seok Il Jung, and Dongho Kim, J. Phys. Chem. Lett. 2017, 8, 884−888, (DOI): 10.1021/acs.jpclett.7b00072

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: **YES**/~~NO~~ Soft Matter and Biological Physics: ~~YES~~/**NO**
Quantum Physics: **YES**/~~NO~~ Theoretical Physics: ~~YES~~/**NO**