INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique des Solides
CNRS identification code: UMR8502
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Web page: : https://equipes2.lps.u-psud.fr/sqm/
Internship location: LPS, bat 510, Université Paris-Saclay, faculté des sciences d'Orsay

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: CNRS

Spectroscopy of Quantum Spin Liquids in Frustrated Magnets

Quantum spin liquids are fascinating new states of matter. Unlike conventional ferro- or antiferromagnetic ground states consisting of long-range ordered spins, spin liquids are entangled disordered states, which breaks the paradigm of the Landau-Ginzburg-Wilson theory of phase transitions. Quantum fluctuations are so strong that the semi-classical picture of individual spins, relevant for conventional states, completely collapses. Instead, the spins combine to form singlet states. Spin liquid states result from the quantum superposition of these individual singlets forming a highly entangled state. A common footprint of these states is the emergence of unconventional excitations, fractional spinons, photon modes, majorana fermions... which can be detected experimentally (Fig. 1). Several materials are now synthesized and studied around the world and in our group for their unique magnetic properties. Rare earth pyrochlores, kagome and Kitaev magnets or quantum materials with strong spin-orbit coupling that exhibit frustrated lattices are promising avenues for achieving such exotic states (Fig. 1).

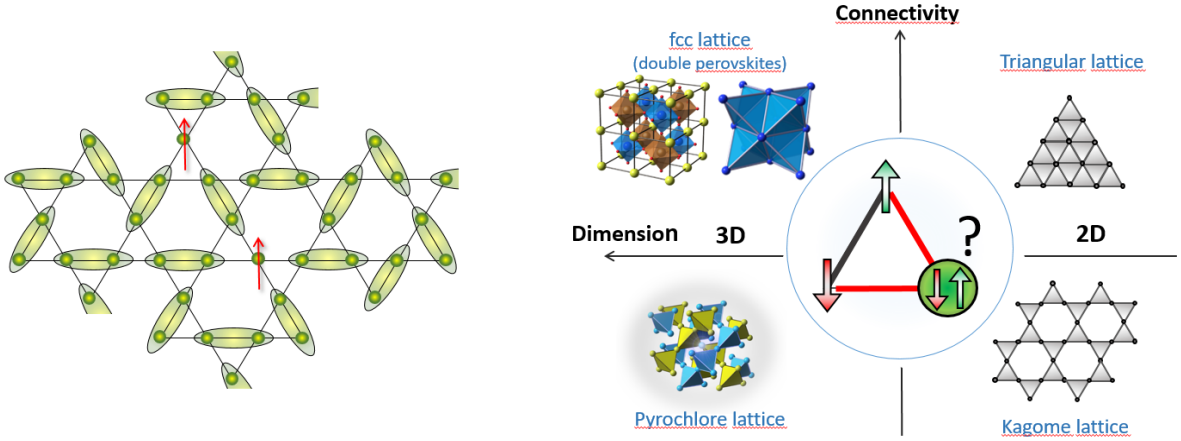

Fig. 1. Left: Spinon excitation among a spin-singlet configuration on a kagome lattice. Right: Quantum materials with frustrated geometries.

The M2/PhD student will study such new spin liquid materials thanks to our well-established international collaborations, with an original experimental approach combining very complementary high-resolution spectroscopic techniques (NMR, muon spin relaxation, inelastic neutron scattering) and bulk thermodynamic measurements (ultrasound, specific heat) at very low temperature; pursuing our recent achievements in the field [see Phys. Rev. B 107, 125156 (2023), Nature Commun. 8, 14810 (2017), Nat. Phys. 16, 469-474 (2020) and Phys. Rev. X 12, 021015 (2022)].

Keywords: quantum magnetism, frustration, correlations, spin liquids, resonance
Skills: Good fit for experiments and solid background in solid state physics are welcome.

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

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: NO