PhD/M2 internship Position in Experimental Condensed Matter Physics

Spectroscopy of Quantum Spin Liquids in Frustrated Magnets

Information

3-years PhD funded by CNRS
Joint PhD program (co-tutelle possible, not mandatory): *Université Paris-Saclay (France) & Université de Sherbrooke (QC, Canada)*
Laboratoire de Physique des Solides UMR8502 / Département de Physique Université de Sherbrooke
Doctorate school: *École doctorale Physique en Ile de France EDPIF*
PhD supervisors: Edwin KERMARREC / Jeffrey QUILLIAM
Period: October 1^{st}, 2025 to September 30^{th}, 2028 (PhD) / ~1^{st} semester 2025 (M2 internship)

PhD/M2 internship description

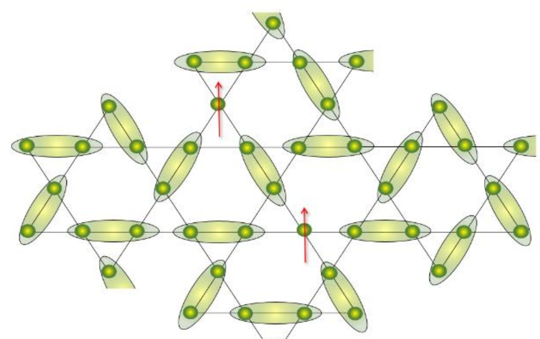

Fig. 1. Spinon excitation among a spin-singlet configuration on a kagome lattice.

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 highly 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 to form a macroscopically 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. 2).
The hired PhD/M2 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 Nature Commun. 8, 14810 (2017), Nat. Phys. 16, 469-474 (2020) and Phys. Rev. X 12, 021015 (2022)].

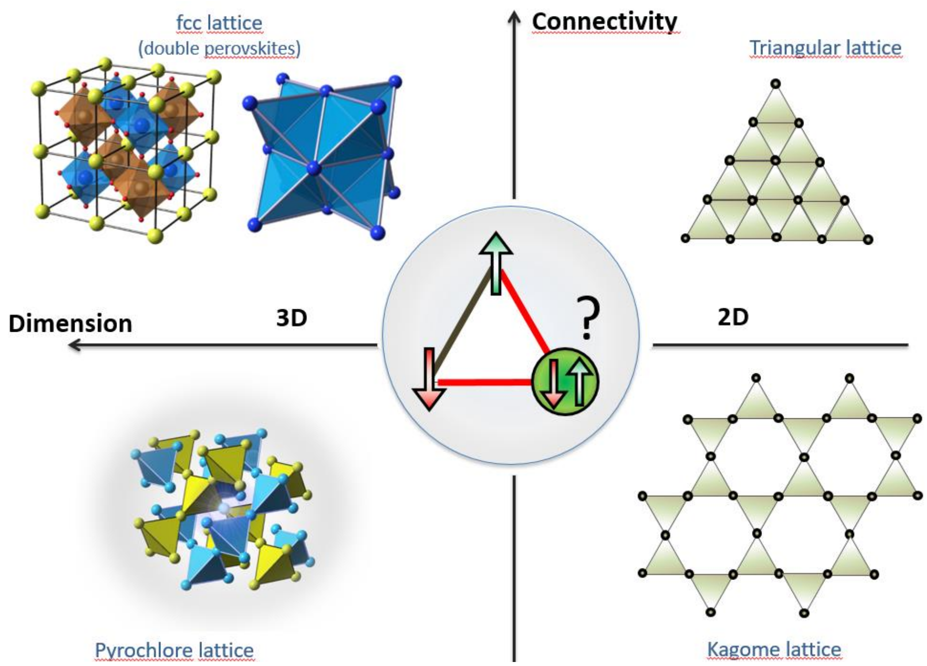

Fig. 2. Magnetic frustration is best illustrated on an antiferromagnetic triangle, where all interactions cannot be simultaneously satisfied (center). There is a variety of frustrated geometries that can be explored in real quantum materials.

Profile

We are seeking a highly motivated candidate, with a strong scientific background in condensed matter physics. He/she should have demonstrated excellent experimental skills, and will have the opportunity to learn state-of-the-art spectroscopic techniques (NMR, muSR, inelastic neutron scattering) along with bulk thermodynamic techniques (ultrasound, specific heat) under extreme conditions (low temperature, high magnetic field) in an international environment. The candidate should hold a Master degree. A good working knowledge of English is mandatory.

Starting date no later than December 2025. The hired PhD student will be based within the Spectroscopies of Quantum Materials team at the *Laboratoire de Physique des Solides* (Orsay, France) and have the opportunity to visit the *Department of Physics, University of Sherbrooke* (QC, Canada). The net salary is fixed by the CNRS and comes with benefits (health insurance, transportation,…).

Contact

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