

PhD Position in Experimental Condensed Matter Physics

Spectroscopy of Quantum Spin Liquids in Frustrated Magnets

Information

Joint PhD program (co-tutelle): *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 1st, 2024 to September 30th, 2027

PhD description

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).

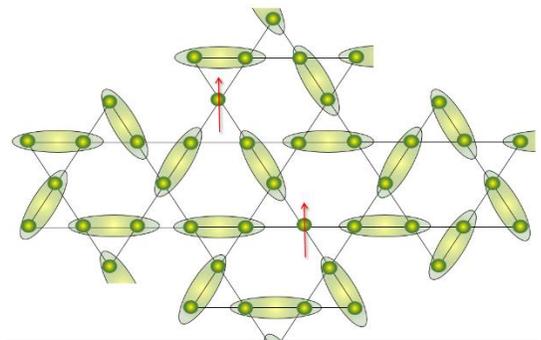


Fig. 1. Spinon excitation among a spin-singlet configuration on a kagome lattice.

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 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 \(2022\)](#)].

Starting date no later than December 2024. The hired PhD student will spend ~2 years within the Spectroscopies of Quantum Materials team at the *Laboratoire de Physique des Solides* (Orsay, France) and ~1 year in the *Department of Physics, University of Sherbrooke* (QC, Canada). The net salary is fixed by the University and comes with benefits (health insurance, transportation,...).

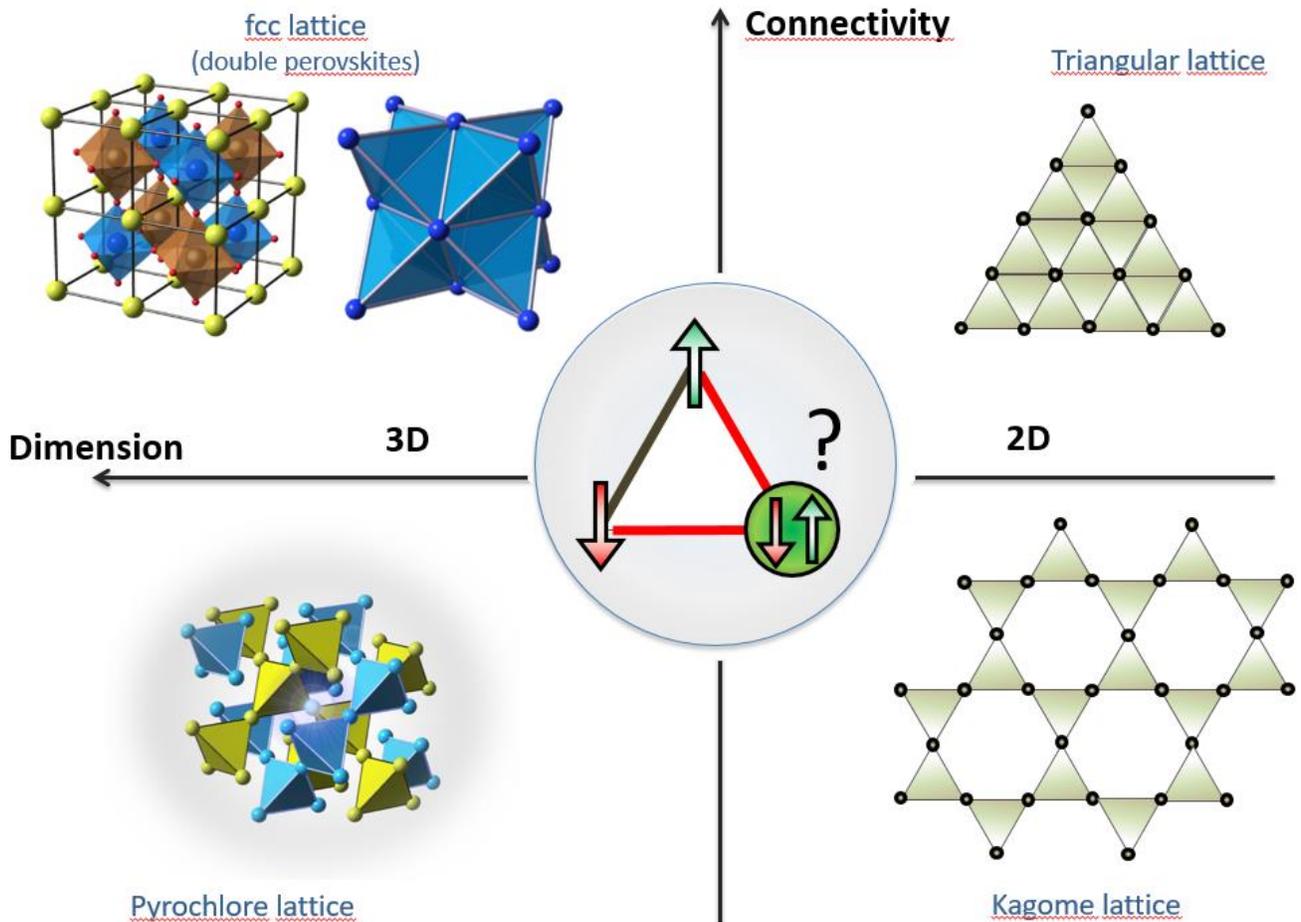


Fig. 2. Magnetic frustration is best illustrated on an antiferromagnetic triangle, where all interactions cannot be simultaneously satisfied (center). There is a variety of frustrated geometries that can be explored in real quantum materials.

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, μ SR, 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.

Contact

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