MASTER 2 RESEARCH INTERNSHIP

Spectroscopy of Quantum Spin Liquids in Frustrated Magnets

Experimental quantum magnetism • Low-temperature spectroscopy

HOST LABORATORY	Laboratoire de Physique des Solides (LPS) · CNRS UMR 8502
LOCATION	Building 510, Faculty of Sciences, Université Paris-Saclay, Orsay, France
SUPERVISORS	E. Kermarrec · edwin.kermarrec@universite-paris-saclay.fr F. Bert · fabrice.bert@universite-paris-saclay.fr
WEBSITE	https://equipes2.lps.u-psud.fr/sqm/
FUNDING for PhD	EDPIF doctorate school | PhD continuation: possible

Scientific context

Quantum spin liquids (QSLs) are unconventional states of matter in which magnetic moments remain disordered even at the lowest temperatures, despite strong interactions between them. Rather than forming conventional long-range ferromagnetic or antiferromagnetic order, their spins develop collective quantum correlations and entanglement. These states challenge the conventional Landau–Ginzburg–Wilson framework of symmetry-breaking phase transitions and the semiclassical picture of individual spins.

Strong quantum fluctuations can promote the formation of entangled singlet states and give rise to exotic excitations carrying fractional or emergent degrees of freedom, such as spinons, emergent photons or Majorana fermions. Detecting these excitations and identifying their signatures in real materials are central challenges in contemporary quantum magnetism.

Frustrated magnetic materials provide promising platforms in which to explore these phenomena. Candidate systems include rare-earth pyrochlores, kagome magnets, Kitaev materials and quantum materials with strong spin–orbit coupling. Several such compounds are currently synthesized and investigated worldwide, including in our research group.

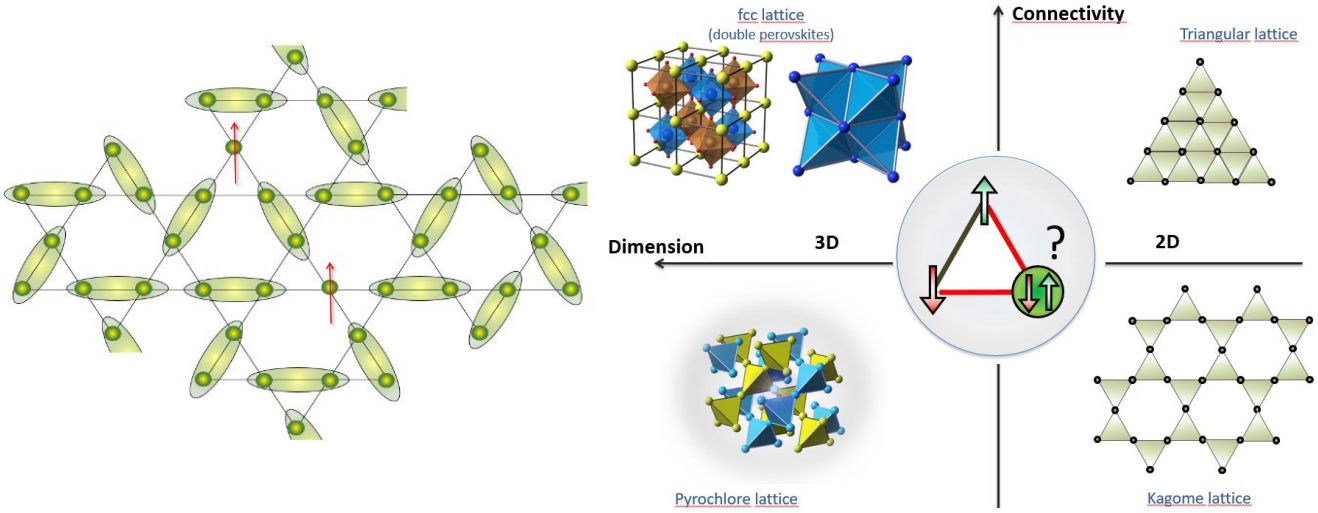


Figure 1. Illustration of a spinon excitation in a kagome spin-singlet configuration (left) and examples of quantum materials with frustrated geometries (right).

Research project

The internship will investigate candidate quantum spin-liquid materials using a complementary set of experimental probes. The project combines high-resolution spectroscopies—nuclear magnetic resonance (NMR), muon spin relaxation (μSR) and inelastic neutron scattering—with bulk thermodynamic measurements, including ultrasound and specific heat, at very low temperatures.

Working within our international collaborations, the student will contribute to the experimental characterization of magnetic correlations and low-energy excitations, and to the discussion of their implications for quantum-spin-liquid behavior. The precise material and experimental focus will be defined according to the project and the student's interests.

Research environment and recent results

This project builds on our group's recent contributions to the field and benefits from established national and international collaborations. Relevant publications include:

- Physical Review Letters 136, 136701 (2026)
- Physical Review Materials 9, 074411 (2025)
- Nature Physics 16, 469–474 (2020)
- Physical Review X 12, 021015 (2022)

Why this internship?

A unique opportunity to:

- Explore one of the most exciting open questions in quantum condensed-matter physics.
- Gain hands-on experience with complementary state-of-the-art spectroscopic techniques.
- Work in a collaborative research environment connected to international projects.
- Develop skills in experimental data analysis and the interpretation of quantum magnetic phenomena.

Candidate profile

This internship is suited to a student with a strong background in solid-state physics and a genuine interest in experimental research. Good experimental skills and motivation to work on low-temperature measurements and quantum magnetism are welcome.

PhD opportunity

A continuation towards a PhD is possible, subject to the project's progress and funding opportunities. CNRS funding is available for the internship; potential PhD funding (EDPIF).

KEYWORDS Quantum magnetism · Magnetic frustration · Quantum correlations · Spin liquids · Spectroscopy

M2 SPECIALITY: Fundamental Concepts of Physics | Condensed Matter Physics: YES | Quantum Physics: YES