Master internship

Title: Quantum spin liquids on the shuriken lattice

Location: Institut Néel, Grenoble

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The internship is funded. It can lead to a PhD, but we do not have funds for the PhD.

Summary:
Imagine that water cannot freeze. You can cool it down for as long as you want, push it down to zero Kelvin, but it stubbornly remains liquid. What would be the properties of such a fluid governed by quantum mechanics ?

If such a question remains a moot point for water, it is at the centre of one of the most active research field in Condensed Matter: the **spin liquids** (see e.g. [1]). In analogy with water, spins in a magnetic material want to order at low temperature. That's for example what happens in a compass. However, in some materials, the very geometry of the magnetic interactions prevents the spins to order down to the lowest accessible temperatures. This is the so-called magnetic frustration. This "frustration" gives rise to spin liquids where spins are at the same strongly correlated and fluctuating ; a little bit as if water could not freeze !

A growing number of such materials has been discovered since the early XXIth century. The beauty of this research field is that each crystal, each model, comes with its own signature. The absence of order at low temperature opens a window to a quantum world that is yet to be explored.

In this internship, we will study the quantum fluctuations of a spin liquid on the "shuriken" lattice [2,3] thanks to Quantum Monte Carlo simulations. This model offers unique opportunities of anomalous quantum entanglement [2] and a large part of its quantum phase diagram remains unknown. The problem is well posed and can open to different directions along the internship.

[1] Essafi, Benton & Jaubert, Nature Comm. **7**, 10297 (2016)
[2] Ralko & Rousochatzakis, Phys. Rev. Lett. **115**, 167202 (2015)
[3] Pohle, Benton & Jaubert, Phys. Rev. B **94**, 014429 (2016)