

Project Title:

Quantum phase transitions between  $Z_2$  spin liquids and valence bond crystals on the Kagome lattice

Name: Xavier Plat

Laboratory at RIKEN: Condensed Matter Theory Laboratory

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1. This project aimed at studying phase transitions between spin liquid and various types of crystals on the Kagome lattice.

QSLs are exotic quantum states, which appear to be « disordered » as they do not break any symmetry, but still possess some non-trivial order. Thus, they are beyond the traditional framework used to classify the different phases and transitions of condensed matter systems. They are currently an active field of research, in particular using numerical simulations.

However, there are only few models where the presence of QSLs has been firmly established. This is the case for the model, an anisotropic XXZ model on the Kagome lattice, considered in this project.

The objective was to take this model as a starting point and modify it to induce transitions towards crystal phases, which could possibly be exotic quantum critical points. I wanted to clarify this point.

2. I used Quantum Monte-Carlo simulations with a code written in C++.

3. By modifying the original model, I found three crystalline phases appearing from the  $Z_2$  spin liquid. However, despite the theoretical possibility of having non-conventional transitions, the simulations quickly pointed towards first-order transitions, which is the default scenario and is already well-understood. Therefore, there was no real interest in pursuing the simulations on this model.

4. The model studied in this project was a promising playground to study possible exotic phase transitions out of a spin liquid phase. However, it turned out that all the transitions fell in the category of 1<sup>st</sup> order transitions, and therefore do not represent an interesting direction of research.