MASTER INTERNSHIP

Exploration of new magnetic phases at the frontier between 2 and 3 dimensions

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What happens inside matter ? In a magnet, all spins point in the same direction, but sometimes, the crystal geometry prevents such ordering. Spins remain strongly correlated, but in a dynamical way, in the sense that they never get stuck in a given direction. This is a different state of matter called a **spin liquid**, whose excitations can take the form of quasi-particles (see e.g. [1-4]).

This field of research is now one of the most active in Condensed Matter, supported by strong ties between experiments and theory. In this context, the body-centred tetragonal (BCT) lattice is a remarkable example [3,4]. The BCT structure appears in many materials with exotic properties, and its symmetry makes it a perfect place to look for novel magnetic phases, as well as their evolution between 2 and 3 dimensions.

In this theoretical internship, we will study the phase diagram of the BCT lattice with classical Heisenberg spins. The project is divided into two parts: first an analytical approach to describe the low-temperature physics, followed by Monte Carlo simulations to study the temperature dependence of the model; in particular the nature of critical phenomena, the spin-liquid type of correlations or the presence of so-called "hidden" order (in other words, difficult to characterise).

This project can develop into a thesis but one will need to seek external funding. In this case, this project can develop into an international collaboration (Germany, Japan, Brazil) and with experimentalists (especially in Grenoble).

[1] Essafi, Benton & Jaubert, Nature Communications **7**, 10297 (2016)
[2] Jaubert & Holdsworth, Nature Physics **5**, 258 (2009)
[3] Pépin, Norman, Burdin & Ferraz, PRL **106**, 106601 (2011)
[4] Farias, Thomas, Pépin, Ferraz, Lacroix & Burdin, PRB **94**, 134420 (2016)