Oral (invitation)

Spin ice :
from magnetic monopoles to magnetic moment fragmentation

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Magnetic geometrically frustrated systems stabilize a great diversity of unconventional magnetic ground states. These states include complex magnetic orderings, or phases which remain disordered down to the lowest temperatures, despite the presence of strong magnetic correlations in the system. Among these original magnetic states, spin ice has aroused a strong interest for a few decades because it offers a wide playground to study modern concepts of condensed matter physics.

Spin ice possesses a macroscopically degenerate ground state, which is governed by a local constraint called the ice rule [1]. Magnetic excitations in spin ice can be described as magnetic charges, called magnetic monopoles, and which correspond to a violation of the local ice rule [2]. When the magnetic monopole density is large enough, monopoles organize as a crystal of alternating magnetic charges, which results in a so-called fragmented state [3]. The distinctive feature of this state is the coexistence of a correlated but disordered state with an ordered state (see Figure 1), both carried by the same magnetic moments, which are thus said to be fragmented into two parts. Theoretically, these exotic physics are successfully understood by introducing an emergent gauge field description and the concept of Coulomb phase.

In this talk, I will first introduce the rich physics of spin ice and its excitations. I will especially focus on the realizations of spin ice by presenting experimental signatures of spin ice, magnetic monopoles and fragmented states.

[1] M.J. Harris et al., Phys. Rev. Lett. **79**, 2554 (1997)
[3] C. Castelnovo et al., Nature **451**, 42 (2008).
[3] M.E. Brooks-Bartlett et al., Phys. Rev. X **4**, 011007 (2014).

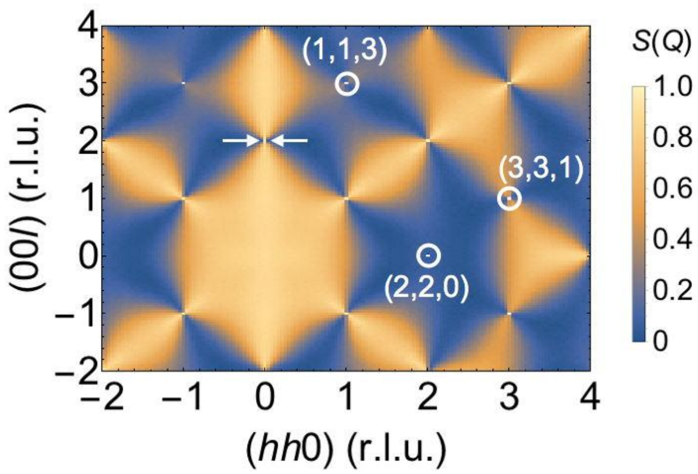

Figure 1 : Calculated magnetic scattering function S(Q) with Q the scattering vector in the reciprocal lattice, for a fragmented phase. It shows a diffuse pattern characteristic of a correlated but disordered phase together with magnetic Bragg peaks (highlighted by circles) characteristic of an ordered state.