Manipulation of magnetic monopoles in spin ice

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PhD funded by the University of Bordeaux for 3 years, starting in October 2018
Keywords: condensed-matter theory, spin liquids, topological phases, emergent phenomena

Project:

Intuitively, matter is expected to order at low temperatures: water becomes ice and iron becomes ferromagnetic. But this intuition breaks down in a series of materials known as "spin liquids", where a frustrated competition between spins prevents the system to order. Spin liquids open a window for exotic properties of matter that are not "hidden" anymore by long-range order. A growing number of such materials are regularly discovered, making this field extremely active, and supported by strong ties between experiments and theory. On that front, spin liquids can often be described by emergent gauge fields with quasi-particle excitations, such as magnetic monopoles in spin-ice compounds $Dy_2Ti_2O_7$, $Ho_2Ti_2O_7$ …

In this PhD, we will develop original approaches in order to control these quasi-particles, taking advantage of strong spin-orbit coupling, out-of-equilibrium dynamics (e.g. via a field quench) and magneto-electric effects. This proposal has been designed for a PhD, with a mixture of well posed problems to start with (based on classical Monte Carlo simulations), and open questions to foster the scientific intuition of the student. Depending on the student's preference, the project can be directed towards more quantum questions, and include some analytics. Part of this PhD will be done in collaboration with Prof. Udagawa from the University of Gakushuin in Tokyo, with - if funding permits - exchanges between France and Japan.

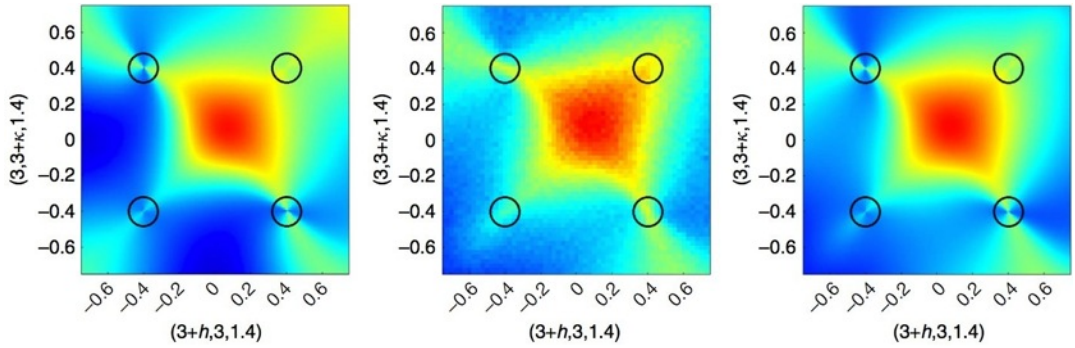

Figure: Signature of a tensor gauge field as would be measured in neutron scattering experiments. Comparison between a continuum field theory (left), simulations (middle) and a large-N approximation (right). Taken from Ref. (3).

Profile & Application: deadline July 13th

We are looking for a very motivated student, with a Master in Physics, a solid background in condensed-matter, statistical and/or theoretical physics, and an interest in simulations. The candidate is expected to be proficient in English and/or French. To apply, please send me an email with your CV, a letter of motivation and the transcript of marks of your Master (M1 & M2). Letters of recommendations and informal inquiries are welcome. Applications will be reviewed as received, with the position remaining open until filled.

For more details about our research, please have a look at some of our recent publications:

(1) Jaubert, Lin, Opel, Holdsworth, Gingras, Physical Review Letters 118, 207206 (2017)
(2) Taillefumier, Benton, Yan, Jaubert, Shannon, Physical Review X 7, 041057 (2017)
(3) Benton, Jaubert, Yan, Shannon, Nature Communications 7, 11572 (2016)
(4) Essafi, Benton, Jaubert, Nature Communications 7, 10297 (2016)
(5) Jaubert *et al*, Physical Review Letters 115, 267208 (2015)