**Department of Physics**
Condensed Matter Physics
Clarendon Laboratory, Parks Road, Oxford OX1 3PU

UNIVERSITY OF OXFORD

# CONDENSED MATTER PHYSICS SEMINAR

Thursday 29 January at 14:30
Simpkins Lee Seminar Room, Department of Physics
(https://maps.app.goo.gl/WjG71uLF2D48n85B6)

## Topological transitions in a frustrated magnet

Professor Santiago Grigera
University of Oxford

Frustrated magnetic systems provide a rich setting for the emergence of unconventional collective behaviour, in which the essential physics is often governed by topology rather than by conventional symmetry breaking. Spin ice is a particularly striking example, combining a simple microscopic structure with a wealth of exotic emergent phenomena, including fractionalized excitations and unusual phase transitions driven by extended objects rather than by the development of local order.

In this colloquium, I will discuss two examples of such topological transitions in spin-ice systems. First, I will present experimental evidence for the theoretically predicted three-dimensional Kasteleyn transition in the canonical spin-ice materials Dy  T2O7 and Ho2Ti2O7. In this transition, string-like excitations are responsible for destabilising a simple polarized state.

I will then turn to a related transition that arises in a modified spin-ice system whose low-energy behaviour is more naturally described in terms of a dense fluid of emergent magnetic monopoles. Using theoretical arguments and numerical simulations, I will show that a topological transition takes place that, although driven by extended excitations, differs from a conventional Kasteleyn transition, exhibiting critical behaviour consistent with the three-dimensional Ising universality class. An unusual feature of this transition is that the magnetic response is governed not by the standard susceptibility exponent, but by that of the specific heat. I will discuss the physical origin of this behaviour and the prospects for experimental realization.

Finally, I will describe magnetic-noise measurements that probe the low-temperature dynamics of spin-ice materials. These experiments reveal anomalous dynamical signatures arising from the constrained motion of magnetic monopole excitations, whose trajectories are restricted by the underlying geometry, leading to fractal-like trajectories for excitations.

*Host: Professor Amalia Coldea*