Department of Physics
Condensed Matter Physics
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UNIVERSITY OF OXFORD

CONDENSED MATTER SEMINAR

Thursday 7 November at 2.15pm

"Magnetic and Structural Coulomb Phases"

Dr Tom Fennell
Paul Scherrer Institute, Switzerland

A Coulomb phase is a state of matter in which the organization and correlations of the local degrees of freedom are described by an emergent non-divergent field rather than a conventional order parameter and broken symmetry. The excitations of such systems will generally be topological defects and/or cooperative fluctuations of this field, rather than transverse (Goldstone) or longitudinal (Higgs) fluctuations of the order parameter. From these very general considerations, concrete examples can be identified, based on models of diverse degrees of freedom including spins (spin ice, quantum spin ice, and classical spin liquids such as the pyrochlore Heisenberg antiferromagnet), charges (charge ice), hydrogen-bonded molecular networks (two- and three-dimensional ice and related vertex models), or dimers. The pyrochlore lattice is often, but not uniquely, the host. In this talk I will illustrate the construction of model Coulomb phases and their experimental signatures, particularly in neutron scattering experiments. I will try to outline the relevance of the concept to topics such as magnetism, emergent many body physics, and the study of materials with strongly correlated structural disorder, as well as touching on the current state of investigations into various realizations: rare earth pyrochlores such as the classical spin ices Ho2Ti2O7 and Dy2Ti2O7, and quantum spin ice candidates such as Tb2Ti2O7 and Pr2Hf2O7; ices of different dimensionalities; and CsNiCrF6, which incorporates both structural and magnetic Coulomb phases.

Host: Prof Siddharth Ashok Parameswaran

Simpkins Lee Room, Beecroft Building