The Abdus Salam International Centre for Theoretical Physics

Conference on Long-Range Interacting Many-Body Systems: from Atomic to Astrophysical Scales (25 - 29 July 2016)

Venue: ICTP Leonardo da Vinci Building - Budinich Lecture Hall
(tel: +39 040 2240346, fax: +39 040 224163, e-mail: smr2830@ictp.it)

Title:
Coulomb Gases in Magnetism

Speaker:
Steve BRAMWELL

Affiliation:
Institutional Research Information Service
London Centre for Nanotechnology
London, U.K.

Abstract:

Spin models are of traditional interest in their ability to model complex systems. Here I will address the question of how spin models can represent Coulomb gases. In the first of two talks I shall confront the general question of how short-range interacting spin models can map to long-range interacting Coulomb gases, emphasising how this can be understood in terms of the properties of lattice electric fields. I shall concentrate on two examples: the well-known 2D-XY model, which maps to a two-dimensional Coulomb gas, and the spin ice model, which maps to a three dimensional Coulomb gas. In both cases I shall expose how an understanding of these models in terms of lattice electric fields affords a new unified perspective and new insights into these systems, highlighting such properties as "topological sector fluctuations" of the harmonic field components. In the case of spin ice the addition of dipole-dipole interactions to the model is shown to generate an accurate description of real magnetic materials, a comprehensive analogy with water ice, and "magnetic monopole" defects that interact Coulombically via real magnetostatic fields. In the second talk I shall go on to describe how spin ice affords an "emergent chemical kinetics" and acts as a model system for the study of charge generation from a vacuum. In this context I shall draw analogies of charge generation processes from diverse areas of physics and show a close agreement between theory and experiment for the time-dependent generation of magnetic monopoles from their associated "vacuum".