Hubbard Model on the Pyrochlore Lattice: A 3D U(1) Quantum Spin Liquid

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Abstract

We demonstrate that the insulating one-band Hubbard model on the pyrochlore lattice contains, for realistic parameters, an extended quantum spin-liquid phase. This is a U(1) spin liquid in three dimensions, formed from a highly degenerate manifold of dimer-based states, which is a subset of the classical dimer coverings obeying the ice rules. The spin liquid has spinon excitations that are both massive and deconfined [1], and on doping exhibits spin-charge separation. We discuss the realization of this spin-liquid phase in effective S = 1/2 pyrochlore systems with and without spin-orbit coupling.

Reference:

[1] Z. Nussinov, C. D. Batista, B. Normand and S. A. Trugman, Phys. Rev. B 75, 094411 (2007).

About the speaker

Prof Bruce Normand received his undergraduate training in physics at the University of Cambridge and his PhD in theoretical condensed matter physics at Massachusetts Institute of Technology. His extensive career as a post-doc and visiting scientist spanned many countries and many topics within the field of strongly interacting electronic materials. From high-temperature superconductivity to low-dimensional systems and from frustrated quantum magnetism to quantum phase transitions, his research has also included molecular nanomagnets, cold atoms, Potts models, transport in nanodevices and the solution physics of biomolecules. Prof Normand is currently a professor in the Department of Physics at Renmin University of China in Beijing.