

Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Valence Bond Entanglement in Random Quantum Magnets"

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Abstract: Several longstanding problems in quantum magnetism concern quenched disorder. I will discuss the role of random exchange energies in spin-1/2 magnets where magnetic frustration promotes the formation of entangled valence bonds. With weak disorder we find that the destruction of a valence-bond solid phase leads inevitably to the nucleation of topological defects carrying spin-1/2 moments. This renormalizes the lattice into a strongly random network of defect spins which yields interesting low-energy excitations. With stronger disorder we find a related instability for a short-ranged valence bond glass. Motivated by these results we conjecture Lieb-Schultz-Mattis-type restrictions on ground states for disordered magnets with spin-1/2 per statistical unit cell. We apply this theoretical study to interpret experimental results on various spin-liquid-candidate magnets including YbMgGaO₄ and H₃LiIr₂O₆. Specific heat, susceptibility, thermal conductivity and dynamical structure factor, as well as their behavior in a magnetic field, are predicted and compare favorably with existing measurements. In particular I will show how recent observations of data collapse in T/H can be understood in terms of scaling laws derived from the theory.

12:00pm noon
Wednesday, February 14, 2018
Duboc Room (4-331)

Host: Max Metlitski