Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

" Fermionic spinon theory of square lattice spin liquids near the Néel state"

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Abstract: Quantum fluctuations of the Néel state of the square lattice antiferromagnet are usually described by a CP1 theory of bosonic spinons coupled to a U(1) gauge field, and with a global SU(2) spin rotation symmetry. Such a theory also has a confining phase with valence bond solid (VBS) order, and upon including spin-singlet charge 2 Higgs fields, deconfined phases with Z2 topological order possibly inter- twined with discrete broken global symmetries. We present dual theories of the same phases starting from a mean-field theory of fermionic spinons moving in π-flux in each square lattice plaquette. Fluctuations about this π-flux state are described by 2+1 dimensional quantum chromodynamics (QCD3) with a SU(2) gauge group and Nf = 2 flavors of massless Dirac fermions. It has recently been argued by Wang et al. (arXiv:1703.02426) that this QCD3 theory describes the Néel-VBS quantum phase transition. We introduce adjoint Higgs fields in QCD3, and obtain fermionic dual descriptions of the phases with Z2 topological order obtained earlier using the bosonic CP1 theory. We also present a fermionic spinon derivation of the monopole Berry phases in the U(1) gauge theory of the VBS state. The global phase diagram of these phases contains multi-critical points, and our results imply new boson-fermion dualities between critical gauge theories of these points.

12:00pm
Tuesday, November 14, 2017
Duboc Room (4-331)

Host: Max Metlitski