Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Crystalline spin-orbital liquids with an emergent SU(4) symmetry"

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Abstract: A promising approach to realize quantum spin liquids is to enhance the spin-space symmetry from usual SU(2) to SU(N). While the SU(N) symmetry with a general N is implemented in ultracold atoms using nuclear spin degrees of freedom, its realization in magnetic materials is challenging. Here we propose a new mechanism by which the SU(4) symmetry emerges in the strong spin-orbit coupling limit. In d1 transition metal compounds with edge-sharing anion octahedra, the spin-orbit coupling gives rise to strongly bond-dependent hopping between the j=3/2 quartets, which is apparently not SU(4)-symmetric. However, in the honeycomb structure, a gauge transformation maps the system to an SU(4)-symmetric Hubbard model. In the strong repulsion limit at quarter filling, as realized in ?α-ZrCl$_3$, the low-energy effective model is the SU(4) Heisenberg model on the honeycomb lattice, which cannot have a trivial gapped ground state and is expected to host a gapless spin-orbital liquid. By generalizing this model to other three-dimensional lattices, we also propose crystalline spin-orbital liquids protected by this emergent SU(4) symmetry and space group symmetries.

12:00pm
Tuesday, November 21, 2017
Duboc Room (4-331)

Host: Itamar Kimchi