Physics Journal Club Meeting

Quantum dimer models for large-spin ultracold atoms

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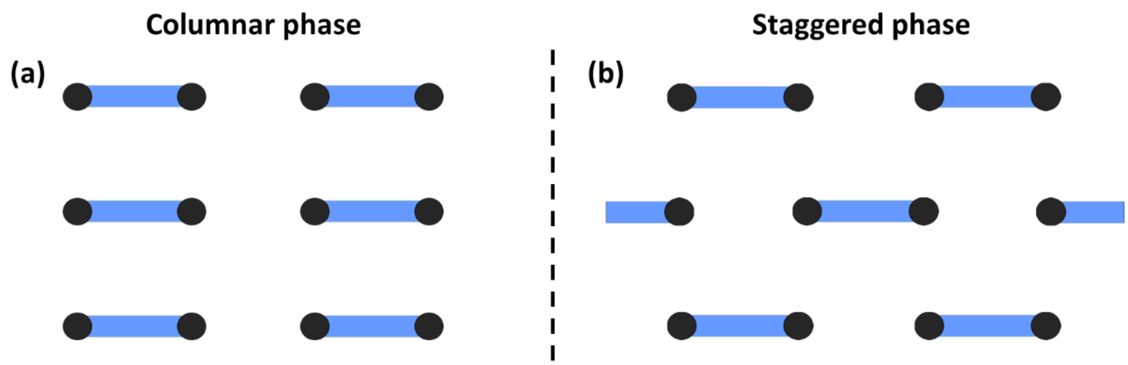
Quantum dimer models—which describe the dynamics of close-packed hard-core dimers on a lattice—are studied for their connection to the resonating valence bond description of high-T_c superconductivity, the appearance of topological order and fractionalized excitations, and their potential applications in quantum computing. However, experimental progress has been inhibited by a lack of solid state systems believed to cleanly realize these models. Meanwhile, cold atomic gases trapped in optical lattices have repeatedly proven their effectiveness as simulators of condensed matter models. Crystallized dimer phases, resonating plaquette phases, and dimer liquid phases—all hallmarks of the quantum dimer model—have already been studied theoretically for cold atoms. In this work, we show that quantum dimer models can successfully describe the low-energy dynamics of cold atom systems, providing a unified description for this large body of previous work. We discuss the anticipated ground states of our system for different lattice geometries, and discuss how several experimental tools unique to cold atoms, such as photo-association and quantum gas microscopy, may be used to detect and study these phases.



Crystallized dimer ground states of the quantum dimer model on a square lattice. Black dots represent atoms in an optical lattice, while blue bonds represent a spin singlet between the connected atoms. (a) The columnar phase is favored when the kinetic energy dominates, maximizing the number of parallel bonds. (b) The staggered phase is favored when the potential energy dominates, minimizing the number of parallel bonds. A variety of exotic phases exist in the intermediate regime connecting these phases.

Friday, December 9th, 2016
Science II Room 144
Pizza @ Noon
Presentation @ 12:15
There will be a sign-in sheet for all attendees to sign