

CM / AMO Seminar

← Condensed Matter & Atomic Molecular Optical →

Thursday, March 1, 2018

→ 705 Pupin Hall

→ 12:15 PM

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"Quantum LEGOs: Building large quantum systems atom-by-atom"

The realization of large-scale controlled quantum systems is an exciting frontier in modern physical science. In this talk, I will introduce a new approach based on cold atoms in arrays of optical tweezers. We use atom-by-atom assembly to deterministically prepare arrays of individually controlled cold atoms. A measurement and feedback procedure eliminates the entropy associated with the probabilistic trap loading and results in defect-free arrays of over 60 atoms [1]. Strong, coherent interactions are enabled by coupling to atomic Rydberg states. We realize a programmable Ising-type quantum spin model with tunable interactions and system sizes of up to 51 qubits. Within this model we observe transitions into ordered states (Rydberg crystals) that break various discrete symmetries, verify high-fidelity preparation of ordered states, and investigate dynamics across the phase transition in large arrays of atoms [2].

An alternative, hybrid approach for engineering interactions is the coupling of atoms to nanophotonic structures in which guided photons mediate interactions between atoms. I will discuss our progress towards entangling two atoms that are coupled to a photonic crystal cavity and I will outline the exciting prospects of this approach for scaling the system to large distances in a quantum network.

[1] Science 354, 1024 (2016)

[2] Nature 551, 579 (2017)

*** lunch will be available ***

