

Abstract Submitted
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Programmable non-local interactions in an ensemble of spin-1 atoms AVIKAR PERIWAL, EMILY DAVIS, GREGORY BENTSEN, ERIC COOPER, MONIKA SCHLEIER-SMITH, Stanford University — Cavity QED experiments provide an ideal framework for understanding quantum systems with long-range interactions. We report on experiments featuring long-range spin-spin interactions between atoms in an optical cavity, driven by a control field that provides flexibility for tuning the strength, sign (ferromagnetic or antiferromagnetic), and spatial structure of interactions. Our experimental setup, which combines non-local interactions with local imaging and addressing, was recently used to image non-local spin exchange in a system with all-to-all interactions [PRL 122, 010405 (2019)]. Extensions of our scheme allow for realizing XXZ models of tunable anisotropy (including isotropic Heisenberg or Ising interactions), and for pruning the interaction graph to form more exotic models. Studying the time evolution of these models experimentally promises insight on quantum dynamics that cannot be easily analytically or numerically obtained.

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