DAMOP19-2019-001011

Abstract for an Invited Paper
for the DAMOP19 Meeting of
the American Physical Society

Controlling Quantum Spin Dynamics with Light

MONIKA SCHLEIER-SMITH, Stanford University

Coupling many atoms to a single mode of light provides an efficient means of generating quantum correlations in an extended many-body system. I will report on experiments in which we harness photons in an optical cavity to mediate flip-flop interactions among distant spins in a millimeter-long cloud of atoms, as we directly observe by real-space imaging of quench dynamics. In our spin-1 system, the exchange interaction enables correlated pair creation in the $m = \pm 1$ Zeeman states, a process analogous to spontaneous parametric down-conversion or to collisional spin mixing in Bose-Einstein condensates. In contrast to direct collisional interactions, non-local light-mediated interactions offer unprecedented opportunities for engineering the spatial structure of spin-spin couplings and correlations. I will describe progress and prospects in tailoring atom-light interactions to enable new directions in quantum simulation and to generate new resources for quantum-enhanced sensing.