

Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

2D Superexchange-mediated magnetization dynamics in an optical lattice ELIZABETH GOLDSCHMIDT, ROGER BROWN, ROBERT WYLLIE¹, SILVIO KOLLER², MICHAEL FOSS-FEIG, TREY PORTO, NIST - Natl Inst of Stds & Tech — The interplay of magnetic exchange interactions and tunneling underlies many complex quantum phenomena observed in real materials. We study nonequilibrium magnetization dynamics in an extended 2D system by loading effective spin-1/2 bosons into a spin-dependent optical lattice, and we use the lattice to separately control the resonance conditions for tunneling and superexchange. After preparing a nonequilibrium antiferromagnetically ordered state, we observe relaxation dynamics governed by two well-separated rates, which scale with the underlying Hamiltonian parameters associated with superexchange and tunneling. Remarkably, with tunneling off-resonantly suppressed, we are able to observe superexchange-dominated dynamics over two orders of magnitude in magnetic coupling strength, despite the presence of vacancies. In this regime, the measured timescales are in agreement with simple theoretical estimates, but the detailed dynamics of this 2D, strongly-correlated, and far-from-equilibrium quantum system remain out of reach of current computational techniques.

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Date submitted: 15 Jan 2015

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