

MAR17-2016-001037

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Exploring quantum magnetism at the single spin and atom level

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Quantum gas microscopes enable the single spin resolved observation and manipulation of ultracold atoms in optical lattices. This powerful tool provides access to novel observables for the characterization of tailored many-body systems. We report on progress on the study of one dimensional ultracold Fermions in an optical lattice, for which we recently observed anti-ferromagnetic correlations at half filling and persisting strong string correlations, connecting to hidden string order at zero temperature, for lower filling. Furthermore, we report on collapse and revival dynamics of the transverse magnetization of long-range interacting Ising spins. The long-range interaction potential of soft-core shape was induced by weak dressing to Rydberg states. This demonstrates that strong tailored interaction potentials can be induced by Rydberg dressing, which preserve the coherent evolution of the many-body system.