Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Progress toward realization of antiferromagnetic ordering of cold atoms in an optical lattice[1] P.M. DUARTE, R. HART, T.L. YANG, J.M. HITCHCOCK, T.A. CORCOVILOS, R.G. HULET, Department of Physics and Astronomy and Rice Quantum Institute, Rice University, Houston, TX 77005 —
We present progress toward the observation of antiferromagnetic (AFM) ordering of fermionic atoms in an optical lattice using Bragg scattering of light. We first laser cool ^{6}Li atoms using the $2S_{1/2} \rightarrow 2P_{3/2}$ transition and then further cool using the $2S_{1/2} \rightarrow 3P_{3/2}$ transition to T $\sim$ 65 μK, leading to enhanced loading into a far detuned optical dipole trap. After forced evaporative cooling, an incoherent spin mixture of the two lowest magnetic sublevels of the ground state is adiabatically loaded into a 3D optical lattice. By adjusting the s-wave scattering length and the depth of the lattice, we tune the interaction and hopping terms of the Hubbard Hamiltonian. Bragg scattering of light from the lattice planes can be used to detect sample ordering such as in the Mott insulator state. At low temperatures and weak interactions, a phase transition to AFM ordering of the two spin states is predicted to occur. The increased symmetry of the AFM state allows for Bragg scattering of light from the ordered spin planes, $\pm(1/2\,1/2\,1/2)$, and hence unambiguous detection of the AFM state. We present our progress in detecting the Mott insulator and AFM states.

[1]Supported by NSF, ONR, DARPA/ARO, and the Welch and Keck Foundations

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Date submitted: 03 Jan 2011 Electronic form version 1.4