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Progress Toward Realization of the 2D Hubbard Model J. R. WILLIAMS, T. M. ESSINGER-HILEMAN, R. STITES, K. M. O'HARA, Penn State University — A two-dimensional (2D) Hubbard model which considers spin-1/2 fermions on a 2D lattice with repulsive interparticle interactions is known to describe magnetic ordering in the cuprates and may describe a mechanism for high-temperature superconductivity as well. To experimentally realize the 2D Hubbard model, we will confine a degenerate gas of ^{6}Li atoms in a three-dimensional cubic lattice in which atoms are restricted, by a proper choice of laser intensities, to move within 2D planes. A repulsive molecular interaction between the atoms mimics Coulomb repulsion and, in combination with Fermi statistics, can lead to an exchange interaction which prefers anti-ferromagnetic ordering. An anti-ferromagnetically ordered state on a two dimensional square lattice is expected for unit occupancy while a superfluid phase with *d*-wave pairing may occur at reduced filling fraction [1]. Also of interest are 2D lattices with geometries that frustrate anti-ferromagnetic ordering, possibly resulting in a spin-liquid phase. We will report on our progress toward realizing the Fermi-Hubbard model with a ^{6}Li gas and the prospects for observing anti-ferromagnetic ordering, *d*-wave superfluidity and a spin-liquid phase in this system. We will also describe our development of a tunable, high-power, solid-state laser source for spectroscopy near 671 nm which provides light for both the ^{6}Li magneto-optical trap and the optical lattice beams.
[1] Phys. Rev. Lett. **89**, 220407 (2002).

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