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Magnetic order by adiabatic demagnetization for fermions in an optical lattice ANTHONY E. MIRASOLA, Rice University, MICHAEL L. WALL, JILA, KADEN R. A. HAZZARD, Rice University — The Fermi-Hubbard model describes ultracold fermions in an optical lattice and exhibits antiferromagnetic long-ranged order below the Neel temperature. However, reaching this temperature in the lab has remained an elusive goal. In other atomic systems, such as trapped ions, low temperatures have been successfully obtained by adiabatic demagnetization, in which a strong effective magnetic field is applied to a spin-polarized system, and the magnetic field is adiabatically reduced to zero. There is a fundamental obstacle to applying this approach to the Fermi-Hubbard model: it possesses an SU(2) symmetry that introduces many level crossings which prevent the system from adiabatically reaching the Fermi-Hubbard ground state, even in principle. However, by breaking the SU(2) symmetry with a spin-dependent tunneling, we point out that adiabatic demagnetization can in principle achieve low temperature states. Such spin dependent tunnelings can be engineered by multiple techniques. Using density matrix renormalization group (DMRG) calculations in one dimension, we numerically find that for sufficiently slow demagnetization protocols, low temperature states can be reached, and we will describe how to optimize this protocol to be experimentally viable.

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