Abstract Submitted
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Cooling fermions in optical lattices by faster entropy redistribution[1] RAFAEL P TELES, TSUNG-LIN YANG, Rice University, THEREZA PAIVA, Universidade Federal do Rio de Janeiro, RICHARD T. SCALETTAR, UC Davis, STEFAN S. NATU, University of Maryland, RANDALL G. HULET, KADEN R. A. HAZZARD, Rice University — Lower entropy for fermions in optical lattices would unlock new quantum phases, including antiferromagnetism and potentially superconductivity. We propose a method to cool these systems at temperatures where conventional methods fail: slowly turning on a tightly focused optical potential transports entropy from the Mott insulator to a metallic entropy reservoir formed along the beam. Our scheme places the entropy reservoir close to the targeted cooling region, which allows entropy redistribution to be effective at lower temperatures than in prior proposals. Furthermore we require only a straightforwardly-applied Gaussian potential. We compute the temperatures achieved with this scheme using an analytic $T \gg t$ approximation and, for low T, determinantal quantum Monte Carlo. We optimize the waist and depth of the focused beam, and we find that repulsive potentials cool better than attractive ones. We estimate that the time required for entropy transport under nearly adiabatic conditions at these low temperatures is compatible with the system lifetime. Finally, we explore further improvements to cooling enabled by sophisticated potential engineering, e.g. using a spatial light modulator.

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