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Title: Thermodynamics of Strongly Interacting Fermions in 2D Optical Lattices

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For more than twenty years, starting shortly after the discovery of high-temperature superconductivity, the Hubbard model has played a fundamental role in analytical and numerical studies that aim at understanding the mechanism of superconductivity in cuprate materials. A new tool of exploring this model, namely, experiments with ultracold quantum gases, has recently been added to the traditional approaches. These three venues have started to closely interact, which has resulted in impressive advances in recent years. In this work, we aim at bridging the gap between theory and experiments with ultracold lattice fermions, by providing precise results for finite temperature properties of strongly correlated fermions in two-dimensional optical lattices, governed by the Hubbard model. We use numerical linked-cluster expansions [1], a method that does not suffer from statistical or systematic errors, and which, within its convergence region, yields exact results directly in the thermodynamic limit. We calculate the equation of state, entropy, double occupancy, and spin correlations at temperatures significantly lower than those obtained by other exact methods and for a wide range of interactions, including the strongly correlated regime that is relevant to optical lattice experiments. We also use the local density approximation to study the properties of trapped systems. In particular, we discuss possible cooling schemes that may enable the achievement of antiferromagnetism and/or superconductivity in those systems [2]. References: [1] M. Rigol, T. Bryant, and R. R. P. Singh, Phys. Rev. Lett. 97, 187202 (2006). [2] E. Khatami and M. Rigol, arXiv:1104.5494 (2011).