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Quantum Monte Carlo simulations and thermometry in ultracold quantum gases

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Modern quantum Monte Carlo algorithms allow accurate simulations of both bosons and fermions in optical lattice at the temperatures relevant for cold atomic gases in optical lattices. These simulations allow quantitative validation of optical lattice experiments, and to use comparison to simulations for thermometry. I will review the state of the at of QMC algorithms for bosons and fermions, and present an overview of results obtained that are relevant for optical lattice experiments, including full thermodynamic data and the equation of state for the fermionic and bosonic Hubbard model. I will then focus on a proposal for universal thermometry in bosonic quantum gases [Qi Zhou and Tin-Lun Ho, PRL 106, 225301 (2011)], based on a generalized fluctuation-dissipation theorem. By applying a their scheme to our QMC results I will show that a variant of their proposal does indeed provide a reliable method for thermometry in quantum gases.