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The Fluctuation-Dissipation Theorem at Low Temperatures in a 2D Optical Lattice¹ ERIC DUCHON, Department of Physics, The Ohio State University, YASUYUKI KATO, Theoretical Division, Los Alamos National Laboratory, NAOKI KAWASHIMA, Institute for Solid State Physics, University of Tokyo, NANDINI TRIVEDI, Department of Physics, The Ohio State University — We calculate local density fluctuations and the local compressibility² of bosons in a two dimensional optical lattice as a function of temperature T and the tuning parameter U/t, the on-site boson repulsion strength in units of hopping, using worldline Quantum Monte Carlo. Our numerical results, coupled with the quantum fluctuation-dissipation theorem applied locally, make significantly different predictions for direct simulations of lattice bosons in a harmonic trap versus simulations that treat the trap within a local density approximation, especially at low temperatures. We discuss implications of our results for local thermometry, equilibration and characterization of the quantum critical regime.

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