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Suppression of the critical temperature for superfluidity near the Mott transition: validating a quantum simulator S. TROTZKY, U. SCHNORRBERGER, J. THOMPSON, I. BLOCH, Uni Mainz, D, L. POLLET, N. PROKOF'EV, B. SVISTUNOV, Univ. of Massachusetts, Amherst, USA, F. GERBIER, LKB Paris, F, M. TROYER, ETH Zürich, CH — Ultracold atoms in optical lattices have proven to be controllable, tunable and clean implementations of strongly interacting many-body systems. The large overlap of reachable Hamiltonians with condensed matter physics opens the possibility to use them as quantum simulators. A crucial step towards this goal is the validation of the experimental measurement for representative benchmark problems which are in reach of current numerical methods. We present the first ab-initio comparison between experiments and quantum Monte Carlo simulations for a large scale Bose gas (up to N 3×10^5) in an optical lattice potential. Using the simulation data to validate each step in the evaluation of the experiment, we are able to measure the finite temperature phase diagram of the system. We directly observe the suppression of the critical temperature T_c for condensation upon approaching the Mott transition. Here, we rely on the sudden appearance of sharp interference peaks, signalling the onset of long range phase coherence as the temperature is decreased. This approach has been questioned lately and we demonstrate, how it can lead to a reliable estimate of T_c by evaluating both the weight and width of the peaks.

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