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Algorithms deducing thermodynamic and quantum critical properties of homogenous bulk systems from the data of trapped gases[1]

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The goal of Quantum Simulation – i.e. using cold atoms to simulate quantum many- body systems – is to find out the properties of bulk homogeneous systems. Cold-gas experiments, however, are carried out in spatially inhomogeneous confining traps, which leads inevitably to different phases in the sample. This makes it difficult to deduce the properties of homogeneous phases with standard density imaging, which averages over different phases. Moreover, important properties like superfluid density are inaccessible by standard imaging techniques, and will remain inaccessible even when systems of interest are successfully simulated. Here, we present algorithms for mapping out a number of properties of homogeneous systems, including superfluid density. In addition, we present algorithms to determine the emergence and the details of quantum critical properties. Our schemes make explicit use of the inhomogeneity of the trap, turning the source of difficulty into a means of constructing solutions.

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