

Tutorial: Detecting and Controlling Correlations and Entanglement in Ultracold Atomic Gases

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Abstract:

Ultracold atomic gases in optical lattices offer unique opportunities to engineer and detect strongly interacting quantum phases. By controlling the underlying lattice potentials, controlled generation of robust entangled states is also possible in a massively parallel way. In addition, single-site and single-atom resolved fluorescence readout of the atomic many-body system now allows to obtain single snapshots of a large many-body quantum system, thus enabling in principle to reveal all higher order density correlations of the system. By manipulating and detecting atoms on lattice sites individually, it should also be possible to implement One-Way Quantum Computing in a lattice setting. In my tutorial, I will introduce these novel preparation and detection techniques. I will show, how these can be applied to solving fundamental problems in quantum information processing and quantum simulations.