Can Quantum Gas Microscopes Directly Image Exotic Glassy Phases?

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With the advent of spatially resolved fluorescence imaging in quantum gas microscopes (see e.g. [1]), it is now possible to directly image glassy phases and probe the local effects of disorder in a highly controllable setup. Here we present numerical calculations using a spatially resolved local mean-field theory, show that it captures the essential physics of the disordered system, and use it to simulate the density distributions seen in single-shot fluorescence microscopy [2]. From these simulated images we extract local properties of the phases which are measurable by a quantum gas microscope and show that unambiguous detection of the Bose glass is possible. In particular, we show that experimental determination of the Edwards-Anderson order parameter is possible in a strongly correlated quantum system using existing experiments. We also suggest modifications to the experiments by using spatial light modulators (see [3] and references therein) to tailor the lattice, which will allow further properties of the Bose glass to be measured.

References:

[1] E Haller, et al., "Single-atom imaging of fermions in a quantum-gas microscope" Nature Physics **11**, 738 (2015)

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[3] F Buccheri, et al., "Holographic optical traps for atom-based topological Kondo devices" New J. Phys. **18**, 075012 (2016)