Superglass phase of interaction-blockaded gases on a triangular lattice

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Abstract

Much effort has been devoted to the study of glassy phases for lattice systems, and in particular to the coexistence of glassiness behaviour with quantum effects, like Superfluidity or Bose-Einstein Condensation. These superglass phases have been observed in continuous space systems and in lattice models, but up to now their experimental realization remains inconclusive.

We investigate the quantum phases of monodispersed bosonic gases confined to a triangular lattice and interacting via a class of soft-shoulder potentials. Using exact quantum Monte Carlo simulations, we determine the equilibrium phases of the model to be a superfluid, a supersolid, and a crystal for increasing interaction strength.

Quenching in temperature results in the appearance of a glass and a superglass region, for strong and intermediate values of the interaction strength, respectively. These glass phases are obtained in the absence of externally induced frustration in the model (usually employed to generate glassy behaviour) and, in the case of the superglass phase, glass physics coexists with a sizable superfluid fraction.

The interactions we choose to simulate are relevant for experiments with Rydberg-dressed atoms in optical lattices, and therefore these phases should be possible to observe in state-of-the-art experimental setups.

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