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Ultracold atomic gases at negative absolute temperatures

Ultracold atomic clouds are used to simulate a broad range of complex quantum systems with a high degree of experimental control. We will discuss that current techniques allow for a realization of an out-of-equilibrium situation where the system relaxes to a state with negative absolute temperature, T_{j0} . Under these conditions, higher energy levels are more likely occupied than lower energy levels. As a consequence, bosonic atoms in an optical lattice condense at finite momenta, at the maxima instead of the minimum of the kinetic energy. A further interesting possibility of using T_{j0} is that one can experimentally reach new parameter regimes. This idea could be applied to simulate the $SU(3)$ attractive Hubbard model with repulsively interacting atoms, which can prove useful to understand some puzzles of quantum chromodynamics.

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