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Cooling and thermalization of one-dimensional bosonic systems

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ABSTRACT

The thesis is structured around the question of how classical physics emerges from the quantum in the case of one-dimensional many-body systems. The first part of the thesis resolves the long-standing issue of why the experimental technique of `evaporative' cooling is so effective in application to the one-dimensional Bose-Einstein quasicondensate, despite the fact that the latter represents a quantum integrable system to a high degree of accuracy. I present a novel theory based on the Luttinger liquid formalism that explains cooling without any need of thermalization. The theory agrees with experimental data well. The second part concerns thermalization after a quantum quench in a mesoscopic one-dimensional Bose-Hubbard chain, which describes bosonic atoms in optical lattices. Using numerical simulations I show how thermalization proceeds at integrability crossover and try to reveal the role played by the eigenstate thermalization hypothesis, entanglement in the eigenbasis, quantum chaos, generalized Gibbs ensemble, and kinetic Boltzmann equation.