

Loschmidt echo and the many-body orthogonality catastrophe in a qubit-coupled Luttinger liquid

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Abstract:

We investigate the many-body generalization of the orthogonality catastrophe by studying the generalized Loschmidt echo of Luttinger liquids (LLs) after a global change of interaction. It decays exponentially with system size and exhibits universal behavior: the steady state exponent after quenching back and forth n -times between 2 LLs (bang-bang protocol) is $2n$ -times bigger than that of the adiabatic overlap, and depends only on the initial and final LL parameters. These are corroborated numerically by matrix-product state based methods of the XXZ Heisenberg model. An experimental setup consisting of a hybrid system containing cold atoms and a flux qubit coupled to a Feshbach resonance is proposed to measure the Loschmidt echo using rf spectroscopy or Ramsey interferometry.