Freie Universität Berlin

Colloquium
Dahlem Center for Complex Quantum Systems

Non-equilibrium steady states of the boundary-driven Heisenberg quantum spin chain

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Abstract:

We consider an open Heisenberg quantum spin chain, coupled at the ends to boundary reservoirs polarized in different directions, which sets up a twisting gradient across the chain. We derive a matrix product ansatz for the non-equilibrium density matrix. For the isotropic chain we calculate the exact magnetization profiles and magnetization currents in the nonequilibrium steady steady state of a chain with N sites. The magnetization profiles are harmonic functions with a frequency proportional to the twisting angle θ. The currents of the magnetization components lying in the twisting plane and in the orthogonal direction behave qualitatively differently: In-plane steady state currents scale as $1/N^{2}$ for fixed and sufficiently large boundary coupling, and vanish as the coupling increases, while the transversal current increases with the coupling and saturates to $2\theta/N$.