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Transport and control of integrable and non-integrable low-dimensional spin-1/2 systems

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Abstract

We analyze transport of local magnetization and develop schemes to control transport behavior in spin-1/2 Heisenberg chains and spin-1/2 Heisenberg two-leg ladders. By adjusting parameters in the Hamiltonians, these quantum systems may show both integrable and chaotic limits. We provide evidence to refute the conjecture that chaotic systems must show diffusive transport, whereas only integrable systems exhibit ballistic transport. In addition, we propose methods of coherent quantum control to suppress the effects of the integrability-breaking terms in the chaotic systems and therefore recover the transport behavior verified in the integrable regime.