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Spin transport in a tunable Heisenberg model NIKLAS JEPSEN, JESSE AMATO-GRILL, IVANA DIMITROVA, Massachusetts Institute of Technology MIT, WEN WEI HO, MIKHAIL LUKIN, EUGENE DEMLER, Harvard University, WOLFGANG KETTERLE, Massachusetts Institute of Technology MIT —
We report on the first realization of the anisotropic Heisenberg model using ultracold atoms with fully tunable anisotropy. So far, only the isotropic Heisenberg model had been realized. We demonstrate this tunability by measuring the transport properties of the Hamiltonian as function of anisotropy in 1D-chains. With increasing anisotropy, we observe a ballistic and a diffusive regime, which are smoothly connected by a super-diffusive regime and followed by a sub-diffusive regime. While we observe this anomalous diffusion for positive anisotropies, negative anisotropies show a behavior which is more reminiscent of transport in a classical gas: ballistic at short relaxation times and diffusive at long relaxation times. We also probe the broken rotational symmetry of the Hamiltonian by rotating the initial state and we find the emergence of an additional relaxation mechanism: local dephasing, which can be controlled by the anisotropy. Finally we directly observe the effective magnetic term in the Hamiltonian, which has its origin in the mapping form the Hubbard model and which has never been observed before.

Niklas Jepsen
Massachusetts Institute of Technology MIT

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