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Emergence of hydrodynamics in a mesoscopic fermi gas

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Hydrodynamics provides a successful framework to effectively describe complex many-body phenomena by coarse graining over microscopic constituents yielding macroscopic quantities. The requirement on the number of averaged microscopic particles is an outstanding question in various fields, ranging from nuclear to high energy physics.

Here, we challenge this condition by using few strongly interacting fermions to probe the hydrodynamic behaviour by means of two complementary observables. We study the dynamics after release from an elliptically shaped optical trap, and the collective excitations of the system by exciting the radial quadrupole mode. In both cases, we observe the emergence of hydrodynamic behaviour with increasing atom number. Tuning the interactions via a Feshbach resonance allows us to show that these processes are indeed driven by interactions.

In addition, we will show first results on rotating few fermion systems. This was enabled by a novel technique to rotate optical potentials, used here to prepare a discrete quantum state with angular momentum.

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