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Scale-Invariant Hydrodynamics and Quantum Viscosity in Fermi Gases[1]

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An optically-trapped gas of spin 1/2-up and spin 1/2-down ^{6}Li atoms, tuned near a collisional (Feshbach) resonance, provides a unique paradigm for testing predictions that cross interdisciplinary boundaries, from high temperature superconductors to nuclear matter. At resonance, the dilute atomic cloud becomes the most strongly interacting, non-relativistic fluid known: Shock waves are produced when two clouds collide. We observe scale-invariant hydrodynamic expansion of a resonantly interacting gas and determine the quantum shear viscosity $\eta = \alpha\hbar n$, with n the density, as a function of interaction strength and temperature, from nearly the ground state through the superfluid phase transition. We extract the local shear viscosity coefficient α from cloud-averaged data, using iterative methods borrowed from image processing, and observe previously hidden features, which are compared to recent predictions.

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