Abstract Submitted
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**Observation of quantum-limited spin transport in strongly interacting two-dimensional Fermi gases** BEN A. OLSEN, CHRIS LUCIUK, SCOTT SMALE, University of Toronto, FLORIAN BÖTTCHER, Universität Stuttgart, HAILLE SHARUM, STEFAN TROTZKY, University of Toronto, TILMAN ENSS, Universität Heidelberg, JOSEPH H. THYWISSEN, University of Toronto — Conjectured quantum bounds on transport appear to be respected in many strongly interacting many-body systems. Since transport occurs as a system relaxes to equilibrium, many such bounds can be recast as an upper bound on the local relaxation rate $k_B T/\hbar$. Systems saturating this "Planckian" bound lack well defined quasiparticles promoting transport. We measure the transport properties of 2D ultracold Fermi gases of $^{40}$K during transverse demagnetization in a magnetic field gradient. Using a phase-coherent spin-echo sequence, we distinguish bare spin diffusion from the Leggett-Rice effect, in which demagnetization is slowed by the precession of spin current around the local magnetization. When the 2D scattering length is tuned near an $s$-wave Feshbach resonance to be comparable to the inverse Fermi wave vector $k_F^{-1}$, we find that the bare transverse spin diffusivity reaches a minimum of $1.7(6)\hbar/m$. Demagnetization is also reflected in the growth rate of the $s$-wave contact, observed using time-resolved rf spectroscopy. At unitarity, the contact rises to $0.28(3)k_F^2$ per particle, measuring the breaking of scaling symmetry. Our observations support the conjecture that under strong scattering, the local relaxation rate is bounded from above by $k_B T/\hbar$.

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