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Experimental demonstration of superadiabatic quantum friction suppression in finite-time thermodynamics[1] AURELIA CHENU, LANL, MIT, SHUJIN DENG, PENGPENG DIAO, FANG LI, SHI YU, East China Normal University, IVAN COULAMY, ADOLFO DEL CAMPO, University of Massachusetts, HAIBIN WU, East China Normal University — Optimal performance of thermal machines is reached by suppressing friction, which in quantum thermodynamics results from fast driving schemes that generate nonadiabatic excitations. The far-from-equilibrium dynamics of quantum devices can be tailored by shortcuts to adiabaticity (STA) to suppress quantum friction, that provide a disruptive approach and allow operating at maximum efficiency with arbitrarily high output power. We experimentally demonstrate the suppression of quantum friction in the finite-time thermodynamics of a strongly-interacting quantum fluid, by implementing friction-free superadiabatic strokes with a unitary Fermi gas in an anisotropic time-dependent trap as a working medium. The control is achieved using STA that exploit the emergent scale-invariance in the unitary regime. We further establish the equivalence between the superadiabatic mean work and its adiabatic value. The enhancement of the mean work output is thus demonstrated in superadiabatic strokes. Combined with cooling and heating steps, superadiabatic strokes can be used to engineer friction-free scalable quantum thermal devices that operate at maximum efficiency with high output power, opening new routes with applications at the interface of quantum thermodynamics and energy science.

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