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Microwave measurements of vortex dynamics in the heavy fermion superconductor CeCoIn$_5$ NATALIE MURPHY, ERIC THEWALT, WENDELL HUTTEMA, COLIN TRUNCIK, KEVIN MORSE, Simon Fraser, JOHN SARRAO, Los Alamos National Lab, Los Alamos, DAVID BROUN, Simon Fraser — Magnetic fields penetrate superconductors as a lattice of quantized tubes of magnetic flux, or "vortices." A transport current, passed through such a superconductor, exerts a transverse component of force on the vortex lattice. Subsequent motion of the vortices results in dissipation. The frictional force experienced by a moving flux line is parameterized by a *vortex viscosity*, and arises from induced electric fields coupling to charge excitations in the vicinity of the vortex core. We present vortex viscosity data on the heavy fermion superconductor CeCoIn$_5$, obtained using sensitive new microwave apparatus that operates at temperatures down to 0.07 mK and magnetic fields up to 9 T. The data we obtain is surprising, and indicates a breakdown of Bardeen–Stephen theory in this material; instead of arising from normal currents in the vortex cores, the frictional forces on the vortices appear to be caused by interactions with d-wave quasiparticles *outside* the cores. This is evident in two ways: from the temperature dependence of the viscosity, which mirrors that of the d-wave quasiparticle conductivity; and from the observation of a new type of Volovik effect, in which the vortex viscosity has a $\sqrt{B}$ dependence on magnetic field.

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