Power spectrum and higher-order structure functions of quantum turbulence in superfluid ^{3}He-B

V. Tsepelin, D.I. Bradley, A.M. Guénault, S.N. Fisher, R.P. Haley, M.J. Jackson, and G.R. Pickett

Physics Department, Lancaster University, Lancaster, LA1 4YB, United Kingdom

We report on studies of quantum turbulence produced by a vibrating grid in ^{3}He-B at low temperatures. Quantum turbulence consists of a tangle of quantized vortex lines which interact via their self induced flow. At very low temperatures there is no normal fluid component and no associated viscosity, nevertheless our measurements show that the frequency spectrum of quantum turbulence displays a power law of -5/3, reminiscent of the Kolmogorov energy spectrum for classical turbulence. The higher-order structure functions are also consistent with predictions from classical turbulence. At the highest frequencies, we see evidence for a cross-over to a -3 power law behaviour. This might give us the first experimental probe of turbulent dynamics at small length scales.