Decay of Quantum Turbulence Generated by Forced Flows of Superfluid ^{4}He

S. Babuin[b], E. Varga[a], and L. Skrbek[a]

[a]Faculty of Mathematics and Physics, Charles University, Ke Karlovu 3, 121 16 Prague, Czech Republic
[b]Institute of Physics ASCR, v.v.i., Na Slovance, 182 21 Prague, Czech Republic

We present an experimental study of the decay of quantum turbulence generated by a forced flow of superfluid ^{4}He down a 105 mm long, 7 mm wide square duct, with and without an obstructing grid. Steady state helium flows with velocity up to 1 m/s are produced by a low temperature bellows, and the turbulence decay originating from different initial intensities is studied in terms of the variation of density of quantized vortex lines as a function of time, deduced from the attenuation of second sound. The removable grid is located 10 mm upstream from the second sound sensors in the middle of the duct and has 0.5 mm mesh size and 0.1 mm tines. We have covered the temperature range $1.17 \leq T \leq 1.95$ K. Both steady state pipe turbulence and grid turbulence, when suddenly switched off, produce a decay of vortex line density across 4 orders of magnitude, lasting some 200 seconds, with a robust power law dependence of the form $t^{-3/2}$. The pipe turbulence decay is compared to a similar experiment where the normal component motion through the channel is prevented by use of superleak filters. The grid turbulence decay is compared to the bench-mark Oregon experiments where a grid was towed in stationary helium.[1] The measured data allow the computation of an effective kinematic viscosity associated with the coupled co-flow of normal and superfluid components of helium.

1. L. Skrbek, J. J. Niemela and R. J. Donnelly, Phys. Rev. Lett. **85**, 2973 (2000)

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