Simulations of the Charge Transport by Quantum Turbulence in ^{4}He at $T \to 0$

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We analysed the results of experiments with two limits of quantum turbulence: a dilute cloud of polarized vortex rings of similar radii and a compact tangle of charged vortex lines under a body force.
In the former, short pulses of up to 10^5 charged vortex rings (CVRs) were injected into the drift space subject to an applied electric field where they propagated to the charge collector while growing in radius R. Numerical simulations were run whereby axially polarised CVRs of a small random radius were stochastically injected into a uniform electric field. If two parent CVRs collide, two daughter CVRs are produced conserving momentum and dissipating a random amount of energy; the charge is redistributed between the daughter CVRs in proportion to their radii. The simulations qualitatively reproduce features of experiment, such as broadening of the spatial distribution, culminating in the production of an elongated tail. Experimentally we observe a critical density of $n_c \sim 4 \times 10^{-4} R^{-3}$ above which CVRs do not propagate due to reconnections. Simulations yield a comparable critical density, $n_c \sim 10^{-3} R^{-3}$.
In the latter, an initially compact charged tangle of vortex loops was propagating and evolving under an applied electric field; the time of flight and spatial spread of its charge were monitored by the currents detected at three different electrodes. By comparing these currents with those found by numerical simulations of a moving Gaussian distribution of charge, reasonable agreement was reached, and suggested the transverse spread of charge, after crossing the cell of length 4.5 cm, was ~ 1 cm.