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Vortex annihilation and inverse cascades in two dimensional superfluid turbulence ANDREW LUCAS, PAUL M. CHESLER, Harvard Univ —
The dynamics of a dilute mixture of vortices and antivortices in a turbulent two-dimensional superfluid at finite temperature is well described by first order Hall-Vinen-Iordanskii equations, or dissipative point vortex dynamics. These equations are governed by a single dimensionless parameter: the ratio of the strength of drag forces to Magnus forces on vortices. When this parameter is small, we demonstrate using numerical simulations that the resulting superfluid enjoys an inverse energy cascade where small scale stirring leads to large scale vortex clustering. We argue analytically and numerically that the vortex annihilation rate in a laminar flow may be parametrically smaller than the rate in a turbulent flow with an inverse cascade. This suggests a new way to detect inverse cascades in experiments on two-dimensional superfluid turbulence using cold atomic gases, where traditional probes of turbulence such as the energy spectrum are not currently accessible.

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