Abstract Submitted
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Giant vortex clusters in a two-dimensional superfluid[1] TYLER W. NEELY, GUILLAUME GAUTHIER, MATTHEW T. REEVES, KWAN GODDARD LEE, University of Queensland, XIAOQUAN YU, ASHTON BRADLEY, University of Otago, MARK BAKER, THOMAS A. BELL, HALINA RUBINSZTEIN-DUNLOP, MATTHEW J. DAVIS, University of Queensland — As first recognized by Onsager, a high energy closed system of 2D point vortices exhibits equilibria characterized by concentrated vortex clusters. Onsager's theory has proved highly-influential, providing understanding of diverse quasi-2D systems such as turbulent soap films and guiding-center plasmas. However, experimental systems demonstrating Onsager's point-vortex statistical mechanics have remained elusive. We report our observation of negative-temperature vortex clusters injected directly into a uniform elliptical BEC, though stirring the condensate with a pair of elliptical barriers. We find that over many seconds of hold time vortex annihilation is suppressed and the clustered fraction is stable, while exhibiting energy loss (cooling) with increasing hold time. We characterize the cooling rate in response to variable non-uniformity of the BEC density and finite temperature. We further characterize axisymmetric and non-axisymmetric equilibria of a single-sign (chiral) vortex gas. We find that an initial nonequilibrium configuration can rapidly thermalize, resulting in an equilibrium state predicted by the point-vortex angular momentum and energy.

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