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An Elliptical Model for Inviscid Damping of a Smooth Vortex Under an Applied Strain Flow[1] P. WONGWAITAYAKORNKUL, J. R. DANIELSON, University of California, San Diego, N. C. HURST, University of Wisconsin-Madison, D. H. E. DUBIN, C. M. SURKO, University of California, San Diego —
The dynamics of a pure electron plasma in a Penning-Malmberg trap have been shown to be a good analog of the dynamics of vorticity in a 2D inviscid incompressible fluid in the presence of an external strain flow [2]. Previously, vortices in the absence of strain were observed to undergo spatial Landau damping, when the vorticity profile is adequately non-flat. We present a model explaining experimental evidence of inviscid damping of the smooth vorticity under the influence of an applied strain flow, accompanied with vortex-in-cell simulations. An elliptical model, describing the dynamics of the smooth vortex as two embedded elliptical patches with preserved vorticity and area, is presented and compared to the experimental and simulation results. The model provides a time-dependent solution to simple coupled ordinary differential equations and analytical expressions for predicting the damping rate and stability of the vortex. Its connection to the strain-free spatial Landau damping is discussed. This work is the first theoretical approach to explain the inviscid damping of the smooth vortex under the presence of irrotational applied strain flow.

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[2]N. C. Hurst, et al., *Phys. Rev. Lett.* **117**, 235001 (2016).

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