Nonlinear, Nonstationary, Self-Organized States in Vlasov Plasmas and Connections to Long Lived Nonlinear States in 2D Euler Flows

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Abstract

We will describe the long time evolution of new states of self-organization in Vlasov plasmas, externally driven for short times, starting from equilibrium. An analogy between pair plasmas described by the Vlasov-Poisson system and 2D Euler vorticity equations will be exploited to describe new non-damped states and their impact for shear flows. Concepts such as Landau Damping, BGK Modes, Plasma Echoes, Quasilinear Theory and Strong Turbulence models will be reviewed and generalized to Kinetic electrostatic Electron (and Positron) Nonlinear Waves (KEEN and KEEPN waves). Further generalizations to multiple interacting KEEN and KEEPN wave states will also be described as a route to statistical mechanical models where geometric shapes (vortices) interacting on myriad scales necessitate memory effects to be taken into account. Connections to Stochastic Loewner Evolution (SLE), conformal invariance and multifractal analysis using geometric measure theory and multiresolution analysis of strong turbulence will be included.

B. Afeyan, F. Casas, N. Crouseilles, A. Dodhy, E. Faou, M. Mehrenberger, E. Sonnendrücker, Simulations of Kinetic Electrostatic Electron Nonlinear (KEEN) Waves with Two-Grid, Variable Velocity Resolution and High-Order Time-Splitting, Eur. Phys. J. D, 68 11, p. 295, (2014).

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