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Unstable shear flows in two dimensional strongly correlated liquids – a hydrodynamic and molecular dynamics study AKANKSHA GUPTA, RAJARAMAN GANESH, Institute for Plasma Research, India, ASHWIN JOY, Indian Institute of Technology Madras, India — In Navier-Stokes fluids, shear flows are known to become unstable leading to instability and eventually to turbulence. A class of flow namely, Kolmogorov Flows (K-Flows) exhibit such transition at low Reynolds number. Using fluid and molecular dynamics, we address the physics of transition from laminar to turbulent regime in strongly correlated-liquids such as in multi-species plasmas and also in naturally occurring plasmas with K-Flows as initial condition. A 2D phenomenological generalized hydrodynamic model is invoked wherein the effect of strong correlations is incorporated via a viscoelastic memory. To study the stability of K-Flows or in general any shear flow, a generalized eigenvalue solver has been developed along with a spectral solver for the full nonlinear set of fluid equations. A study of the linear and nonlinear features of K-Flow in incompressible and compressible limit exhibits cyclicity and nonlinear pattern formation in vorticity. A first principles based molecular dynamics simulation of particles interacting via Yukawa potential is performed with features such as configurational and kinetic thermostats for K-Flows. This work reveals several interesting similarities and differences between hydrodynamics and molecular dynamics studies.

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