3rd Asia-Pacific Conference on Plasma Physics, 4-8,11.2019, Hefei, China

Kinetic Eulerian Simulation of Electrostatic Phase Space Vortices (PSVs) In A Driven-Dissipative Vlasov-Poisson System

Pallavi Trivedi, Rajaraman Ganesh

Institute For Plasma Research, HBNI, Gandhinagar, India, 382428

pallavi.trivedi@ipr.res.in pallavi.trivedi90@gmail.com

Understanding the dynamics of wave-particle interactions, which results into Coherent Phase Space Vortices (PSVs), in plasmas is a subject of extensive effort, for both space plasma environments as well as for laboratory plasma systems. In modeling the kinetic dynamics of a plasma, the collision-free approximation is usually considered. However, from the kinetic point of view, the range of low collisionality can be significantly different from that of null collisionality. This is mainly due to the fact that the kinetic dynamics of a plasma is determined by the details of the particle velocity distribution function where a slight departures from a Maxwellian can produce significant modifications in the dispersion relation of electrostatic waves and particle collisions work to restore thermal equilibrium. The effect of such collisions can eventually change completely the features of the kinetic dynamics of a plasma, even in situations where collisionality can be considered weak. Nearly collisionless regimes are important to a number of physical processes, including runaway electrons in magnetically confined fusion plasmas, magnetic reconnection in weakly collisional regime, low density edge in a tokamak plasma, solar plasma near sunspots, and non-neutral plasmas etc. In such cases, kinetic processes and collisionality are in competition between each other. The evolution of the plasma is, therefore, a result of complex combination of these two effects.

In the present work, an Eulerian time-splitting algorithm for the study of the driven electrostatic phase space vortices (PSV) in an unbounded collisional plasmas is presented. Collisions are modeled through one-dimensional operators of the BGK/Fokker-Planck type. Particular attention is devoted to the study of collisional effects on the formation and dynamics of driven PSVs which have been studies previously for an unbounded collisionless plasma with both Maxwellian and non-Maxwellian distributions[1, 2, 3]. In the present work, using a numerical Vlasov-Poisson solver, we bring out several interesting features of phase space structures in a driven-dissipative system, the details of which will be presented[4].

References
[1] Pallavi Trivedi, R. Ganesh, Physics of Plasmas 23, 062112 (2016).
[2] Pallavi Trivedi, R. Ganesh, Physics of Plasmas 24, 032107 (2017).
[3] Pallavi Trivedi, R. Ganesh, Physics of Plasmas 25, 112102 (2018).
[4] Pallavi Trivedi, R. Ganesh, Manuscript to be submitted, (2019).