Statistical analysis of turbulent front propagation in a 3D Vlasov-Poisson model.

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Velocity-space structures of trapped ion distribution functions are simulated by means of the non-linear gyrokinetic code TIM3D. The semi-Lagrangian scheme allows one to study the whole distribution function in the 3 dimensional reduced model (Energy, radius and angle).

When governed by a heat source, interchange instability gives rise to intermittent transport. This response is very different from that of the system governed by two boundaries at given constant temperatures. In the latter case the temperature profile relaxes to a mean profile with strong temperature gradients in the vicinity of the boundary layers and rather weak temperature gradients over most of the radial extent [1]. In the present simulation, the system is driven by a constant and finite source term. The latter is localised towards the core and such that it does not generate particules but leads to an upshift in energy at constant density.

By analysing turbulence in the unfavorable curvature region ($\nabla_\perp T_i < 0$) through statistical tools, one extracts front propagation features and their relationship to average profiles. Intermittent bursts, called avalanches, account for a significant part of the total transport and develop over large radial scale. Self-generated Zonal flows associated with specific potential structure are observed. The probabilty density function (PDF) of the radial energy flux exhibits large peaks corresponding to outflux and also small magnitude influx associated with avalanches of low temperature compared to the mean temperature profile. As such, these events are reminiscent of intermittent particle transport reported in fluid models. In the gyrokinetic approach these structures are presently investigated in the whole phase space, hence including the energy dependence of the phenomena.

References

[1] Y. Sarazin *et al., "Kinetic features of interchange turbulence"*, to be published