Characterizing non-diffusive transport between self-consistent and external shear flows using Lagrangian trajectories

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This work provides preliminary results on the competing characteristics of non-diffusive transport in the presence of an evolving flux driven background gradient and an external shear flow profile. The motivation arises from previous observations of both supercritical transport in the presence of an evolving mean profile as well as subcritical transport in the presence of sheared flows \cite{1, 3}. This investigation aims to identify transport characteristics when ingredients for both supercritical transport and subcritical transport are included into a numerical model. A simple two-dimensional plasma turbulence model evolves a modified two fields electrostatic plasma fluid turbulence equations with periodic boundaries. The evolution of the background gradient has been added to a basic drift-wave turbulence model that evolves the fluctuating density and potential \cite{2}. Consequently, the background gradient is advected and relaxed by the ExB velocity from the potential fluctuations. In turn, the fluctuations respond to the local scale lengths of the background gradient, which provide noticeable structure in the fluctuating fields leading to a self-consistent evolution of the modified equations. Noticeable self-consistent flows are observed arising from the inhomogeneity in the flux driven background gradient, which can inhibit transport across the flows. Lagrangian trajectories are used to identify the non-diffusive transport parameters in this coupled system of equations. The transport characteristics due to the interactions between self-consistently generated flows and externally imposed can be extracted. In addition, these trajectories also provide comparisons between Lagrangian trajectories and profile evolution due to a perturbation in the evolving background gradient in this model.

References

