

# Effect of zonal flows on flux-driven non-diffusive turbulent transport and profile stiffness

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Non-diffusive turbulent transport and profile stiffness are long standing problems, which have been observed in magnetically confined fusion plasmas. One of such dynamics is the self-organized critical transport observed in a global toroidal simulation, leading to a Bohm-like scaling [1]. Recent advanced flux-driven simulations have also reproduced similar dynamics accompanied by a  $1/f$  type non-diffusive transport [2]. However, the underlying physical mechanism of such dynamics has not been clarified yet.

Here, using a newly developed global gyrokinetic Vlasov code based on the multi-moment scheme [3], we investigated a flux-driven ion temperature gradient (ITG) turbulence. Remarkable features are that the turbulent transport is dominated by active avalanches and the ion temperature profile in source/sink free region is tied to globally constant gradient. Such a profile is found to be hardly changed in the power scan, exhibiting a character of strong profile stiffness.

In order to clarify the underlying physical mechanism of such profile stiffness, we investigated the response of turbulence and associated zonal flows by step-up/down switching experiment for external heat flux. We found that the zonal flow generation is suppressed in a flux-driven ITG turbulence dominated by non-diffusive turbulent transport. On the other hand, the zonal flows are strongly excited once the heat input is turned-off. This suggests that the weak zonal flow generation due to non-diffusive transport is the origin of profile stiffness. This may originate from the fact that the time scale of non-diffusive transport is faster than that of zonal flow generation.

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[3] T. Kawano, *et.al.*, Plasma Fusion Res., **6**, 2401097 (2011).