Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Non-inductive current generation in fusion plasmas with turbulence.[1] WEIXING WANG, S. ETHIER, E. STARTSEV, J. CHEN, Princeton Plasma Phys Lab, T. S. HAHM, M. G. YOO, Seoul National University, Korea —
It is found that plasma turbulence may strongly influence non-inductive current generation. This may have radical impact on various aspects of tokamak physics. Our simulation study employs a global gyrokinetic model coupling self-consistent neoclassical and turbulent dynamics with focus on electron current. Distinct phases in electron current generation are illustrated in the initial value simulation. In the early phase before turbulence develops, the electron bootstrap current is established in a time scale of a few electron collision times, which closely agrees with the neoclassical prediction. The second phase follows when turbulence begins to saturate, during which turbulent fluctuations are found to strongly affect electron current. The profile structure, amplitude and phase space structure of electron current density are all significantly modified relative to the neoclassical bootstrap current by the presence of turbulence. Both electron parallel acceleration and parallel residual stress drive are shown to play important roles in turbulence-induced current generation. The current density profile is modified in a way that correlates with the fluctuation intensity gradient through its effect on k//-symmetry breaking in fluctuation spectrum. Turbulence is shown to deduct (enhance) plasma self-generated current in low (high) collisionality regime, and the reduction of total electron current relative to the neoclassical bootstrap current increases as collisionality decreases. The implication of this result to the fully non-inductive current operation in steady state burning plasma regime should be investigated. Finally, significant non-inductive current is observed in flat pressure region, which is a nonlocal effect and results from turbulence spreading induced current diffusion.

[1]Work supported by U.S. DOE Contract DE-AC02-09-CH11466.

Weixing Wang
Princeton Plasma Phys Lab

Date submitted: 13 Jul 2017 Electronic form version 1.4