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Influence of plasma turbulence on tokamak self-driven current[1]
WEIXING WANG, E. STARTSEV, M. G. YOO, S. ETHIER, J. CHEN, Princeton Plasma Physics Laboratory, T. S. HAHM, Seoul National University — Steady state tokamak operation relies on fully noninductive current for generating the poloidal magnetic field needed for plasma confinement, the majority of which is from plasma self-driven current. The self-driven current also strongly affects key MHD instabilities, such as NTM and ELM. Plasma turbulence due to various ubiquitous micro-instabilities can drive substantial macroscopic plasma current which presents a new pathway to affect tokamak confinement and global stability. The underlying process closely links to turbulence driven momentum transport and flow generation. This study focuses on the quantitative identification of distinct effects, namely, turbulence acceleration, parallel Reynolds stress and fluctuation-induced scattering and detrapping, on current generation at different regimes. It is showed that the size and amplitude of residual stress driven current profile corrugation sensitively depend on q-profile structure. The strong current corrugation at weak magnetic share can drive a seed island for NTM at rational magnetic surfaces. On the other hand, fluctuation-induced effective collisions may considerably reduce the plasma self-driven current in low collisionality regime relevant to high temperature burning plasmas.

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