

Exploring the Regime of Validity of Global Gyrokinetic Simulation with Spherical Tokamak Plasmas

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Abstract

Plasma turbulence is considered one of the main mechanisms for driving anomalous thermal transport in magnetic confinement fusion devices. Based on first-principle model, gradient-driven gyrokinetic simulations have often been used to explain turbulence-driven transport in present fusion devices, and in fact, many present predictive codes are based on the assumption that turbulence is gradient-driven. However, using the electrostatic global particle-in-cell Gyrokinetic Tokamak Simulation (GTS) code [1], we will show that while global gradient-driven gyrokinetic simulations provide decent agreement in ion thermal transport with a set of NBI-heated NSTX H-mode plasmas, they are not able to explain observed electron thermal transport variation in a set of RF-heated L-mode plasmas, where a factor of 2 decrease in electron heat flux is observed after the cessation of RF heating. Thus, identifying the regime of validity of the gradient-driven assumption is essential for first-principle gyrokinetic simulation. This understanding will help us more confidently predict the confinement performance of ITER and future magnetic confinement devices. The work is supported by DOE and computational resource is provided by NERSC.

[1] W.X. Wang et al., Phys. Plasmas 17, 072511 (2010)