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Application of Momentum Theorem to Magnetic Fusion Plasmas

T.S. Hahm[1], M.K. Jung[1], S. Yi[2], and Y.S. Na[1]
[1]Seoul National University, [2]Korea Institute of Fusion Energy
e-mail (speaker): tshahm@snu.ac.kr

The momentum theorem [1] which is widely known in the geophysical fluid dynamics (GFD) community [2] states that "In the absence of forcing, dissipation and enstrophy density flux, stationary turbulence cannot accelerate a zonal flow." Despite of publications highlighting potential relevance in understanding plasma turbulence in magnetic fusion energy (MFE) [3-4], its significance has been under-recognized to date. This presentation covers its extension to toroidal geometry [5], and various applications to MFE problems. This includes a useful understanding of a recent gyrokinetic simulation result [6]. To investigate the dynamics and consequences of PV mixing, we conduct simulations using the global gyrokinetic code gKPSP [7-8]. Our analysis on the simulation results indicates a dominant balance between turbulence spreading and zonal flow generation well after a local saturation of turbulence.

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