Numerical "Solomon" Experiment of Intrinsic Momentum Torque in Flux-driven Global ITG Turbulence[1,2]

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Intrinsic rotation is central to ITER performance, which will not have much extrinsic rotation source. Most simulation studies of rotation physics focused entirely on the radial flux of toroidal momentum, and did not address experimentally measurable rotation profile structure and evolution in the presence of heat flux-driven turbulence. In this study, numerical "Solomon" experiment is performed in XGC1 in which external momentum input can effectively cancel the intrinsic rotation profile and identifies the intrinsic torque and residual stress from ITG turbulence. Without the "Solomon" type cancellation by external momentum input, the global heat flux-driven ITG turbulence simulations in XGC1 clearly indicate the formation of intrinsic macroscopic, mean toroidal flow profile, and the intrinsic torque with no-slip boundary condition. A mean flow is generated to peak with thermal Mach numbers ~ 0.05. The peak flow increases rapidly inward from the edge and is unidirectional. The ion heat flux and the momentum flux are bursty and correlated with each other. The probability distribution function of outward heat flux and inward momentum flux show strong similarity. Correlations between residual stress and two symmetry breakers, ExB shear and intensity gradient are similar. Also, momentum conservation issues of gyrokinetic simulation are clarified.
Ongoing work focuses on scans of macroscopic velocity values vs. heating power and current, in order to recover the Rice scaling.

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