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Zonal Flow Formation in Coupled Drift Wave Turbulence and Parallel Flow Fluctuations: A Computational Study

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We perform nonlinear simulations of a coupled drift wave-parallel flow system, including equilibrium parallel flow shear, to investigate the impact of parallel flow fluctuations on zonal flow (ZF) formation. It is found that the parallel flow fluctuation has strong impact both the radial pattern and amplitude of ZFs. In the drift wave dominant turbulence, ZFs become stronger and coarser as the parallel flow shear increases. This trend of the ZF radial wavenumber is consistent with the modulational instability calculation [Y. Kosuga, Phys. Plasmas 24, 122305 (2017)]. In parallel velocity gradient (PVG) dominant turbulence with large parallel flow shear, the ZF amplitudes become larger, but their radial wave number is also larger as parallel fluctuations increase. Vorticity generation by parallel compression is found as the main mechanism for the ZF generation from parallel fluctuations.