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Toroidal Flow Shear Driven turbulence and Transport[1] WEIXING WANG, S. ETHIER, PPPL, F.L. HINTON, UCSD, T.S. HAHM, SNU, Korea, W.M. TANG, PPPL — New results from global nonlinear gyrokinetic simulations with the GTS code show that strong flow shear can drive a negative compressibility mode [1-3] unstable in tokamak geometry in some experimentally relevant parameter regimes. The modes reside in a low-k range, similar to that of ITG mode, with smaller but almost constant growth rate over a wider k_θ range, while the mode frequency increases strongly with k_θ. More interestingly, the flow shear modes show significantly finite $k_{//}$, unlike ITG and TEM. The nonlinear energy transfer to longer wavelength via toroidal mode coupling and corresponding strong zonal flow and geodestic acoustic mode (GAM) generation are shown to play a critical role in the nonlinear saturation of the instability. The associated turbulence fluctuations can produce significant momentum and energy transport, including an intrinsic torque in the co-current direction. Remarkably, strong "resonance" in the fluctuations and associated transport peaks at the lowest order rational surfaces with integer q-number (rather than fractional), consistent with theoretical calculation. As a consequence, local "corrugations" are generated in all plasma profiles (temperatures, density and toroidal rotation), potentially impacting transport barrier formation near the rational surface. Discussions on flow optimization for minimizing plasma transport will be reported.

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