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Effect of Trapped Electrons on Turbulence driven Toroidal Momentum and Heat Transport W.X. WANG, T.S. HAHM, P.H. DIAMOND, UCSD, S. ETHIER, W.M. TANG, W.W. LEE, G. REWOLDT, W. SOLOMON, S.M. KAYE, J. LANG, R. KOLESNIKOV, PPPL — Using global gyrokinetic simulation, a robust residual stress is found to be nonlinearly generated in both ion temperature gradient (ITG) and trapped electron mode (TEM) turbulence via symmetry breaking in the parallel wave number spectrum, which is induced by turbulence self-generated flow shear. This residual stress represents a significant, universal, non-diffusive component of toroidal momentum transport, which may play an important role for the generation of intrinsic rotation in tokamak experiments. In the ITG marginality regime, trapped electron physics is shown to play a critical role in determining plasma transport, not only producing the proper ion heat flux in experiments but also largely enhancing the residual stress generation. However, trapped electrons do not change the qualitative phase space structure of ITG driven momentum and heat fluxes. On the other hand, TEM driven momentum transport is made by ions from different regions and in a different way in the phase space. Determination of the non-diffusive momentum transport direction (inward or outward) is also examined in connection with the characteristics of the turbulence spectrum. Further, a momentum pinch is shown via simulations using different rigid rotations. Finally, very impressive observations of large eddy formation from earlier phase fine streamers, along with dramatic nonlinear energy cascades to longer wavelengths, in electron temperature gradient driven TEM turbulence is reported. Work supported by U.S. DOE Contract DE-AC02-09-CH11466 and the SciDAC GPS-TTBP project.

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