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# TH/P7-14: Turbulence Generated Non-inductive Current and Flow Shear Driven Turbulent Transport in Tokamaks

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New results obtained from global gyrokinetic simulations regarding turbulence-induced plasma current and flow shear driven turbulence and transport in tokamaks are reported in this paper. i) These plasma self-generated non-inductive parallel currents can have a strong impact on the physics of plasma disruptions and overall plasma confinement. Specifically, their influence on key magnetohydrodynamic (MHD) instabilities such as neoclassical tearing mode (NTM) and edge localized mode (ELM), is of great importance. It is found that the collisionless trapped electron mode (CTEM) and ion temperature gradient (ITG) turbulence can drive significant, quasi-stationary parallel current. The underlying dynamics is closely related to the nonlinear plasma flow generation by turbulent residual stress. However, unlike toroidal momentum, which is mostly carried by ions, the turbulent current is mainly carried by electrons and driven by electron residual stress. The current generation by turbulence exhibits a characteristic dependence on plasma parameters that is similar to plasma flow generation. Specifically, it increases with the pressure gradient, decreases with equilibrium current $I_p$, and increases with the radial variation of the safety factor. Interestingly, the CTEM driven current is essentially carried by trapped electrons, unlike the neoclassical bootstrap current which is mainly carried by passing particles. It is suggested that the predicted characteristic dependence can be examined using large experimental databases, along with crosschecks with fluctuation measurements. ii) Our global nonlinear gyrokinetic simulations show that strong flow shear may drive the negative compressibility mode unstable in tokamak geometry in some experimentally relevant parameter regimes and that the associated turbulence can produce significant energy and momentum transport, including an intrinsic torque in the co-current direction. The generic nature of flow shear turbulence in tokamak plasmas is investigated in detail, including mechanisms for its nonlinear saturation and the influence of the $q$-profile structure. Systematic studies with special attention paid to flow optimization for minimizing plasma transport will be reported.

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