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Turbulent Current Drive Mechanisms

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In this work we discuss the efficiency of various turbulent mechanisms for modifying the plasma current. The first mechanism results from the establishment of an equilibrium between trapped and passing electrons due to resonant scattering by microturbulence. This mechanism is closely analogous to the familiar neoclassical bootstrap current except that it relies on wave-particle interactions to detrap electrons rather than Coulomb collisions. In addition to the above mechanism, mean plasma current can be generated by either: (1) turbulent acceleration, (2) or a "residual stress" term in the electron momentum flux. The former mechanism relies on turbulence mediated exchange of momentum between ions and electrons, whereas the latter corresponds to a non-diffusive contribution to the momentum flux. The contributions from these mechanisms are quantified by employing a mean field formulation that incorporates phase space scattering by drift wave turbulence, turbulent acceleration, and non-diffusive contributions to the electron momentum flux. The impact of these mechanisms on the bootstrap current is assessed by the incorporation of a Coulomb collision operator such that turbulent and neoclassical effects are treated on an equal footing. This work was performed under the auspices of the U.S. DOE by LANL under Contract No. DE-AC52-06NA25396.

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