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Gyrokinetic simulations of an electron temperature gradient turbulence-driven current in tokamak plasmas

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The so-called "spontaneous"or "intrinsic"rotation driven by ion-scale turbulence has been widely observed in tokamaks. If we turn our attention to the electron parallel momentum balance, it is likely that electron-scale turbulence, e.g. electron temperature gradient (ETG) turbulence, can modify the Ohm's law, hence providing a current source. However, there has been no serious study of an ETG-driven current in self-consistent simulations using realistic tokamak geometry. In this work, we report results of a gyrokinetic simulation study elucidating the characteristics of an intrinsic current driven by ETG turbulence in toroidal geometry. We focus on effects of the normalized electron gyroradius rho_e*on the ETG-driven current. Our simulations demonstrate that the amount of the ETG-driven current increases with rho_e*, as expected from the gyro-Bohm scaling. In particular, a perturbation of a q-profile by the ETG-driven current becomes visible when a<4000 rho_e. This finding suggests that a significant intrinsic current can be driven inside an H-mode pedestal where the steep gradient of an electron temperature pedestal can excite ETG turbulence in a narrow region.

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