Kinetic simulation of resonant magnetic perturbation effect on pedestal transport in a tokamak geometry

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Kinetic simulation has been performed, using XGC0 particle code, to study the effect of the n=3 resonant magnetic perturbations* (RMPs) on edge pedestal in a realistic tokamak geometry including the separatrix and the first wall. XGC0 simulation includes ions, electrons and neutrals, with conserving Monte Carlo Coulomb collisions and proper ionization and charge exchange cross-sections. XGC0 simulation also includes heat fluxes from the core and neutral atomic recycling near the wall. XGC0 evaluates kinetic bootstrap current consistently with the ion and electron dynamics in the presence of separatrix. It is found for the first time that the main effect of the RMPs is to drop the pedestal density, with much less effect on the heat transport. The radial electric field E_r becomes positive except just inside the separatrix, where the E_r well persists despite RMPs. Another noticeable change is in the plasma rotation: the toroidal rotation increases by RMPs to the co-current direction in the pedestal and scrape-off regions. The bootstrap current is reduced below the axisymmetric value. Physics behind these RMP effects will be presented. Implication of the RMP-induced changes on the effect of the ELM crash will also be discussed in coupling with the nonlinear M3D MHD code.

*RMP magnetic data provided by I. Joseph of UCSD and the DIII-D RMP team

Research supported in part by US Department of Energy and in part by KSTAR project.