Self-consistent Kinetic Simulation of Stochastic RMP Penetration, Plasma Transport, and Pedestal Response in Diverted Geometry[a), b)]

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The XGC0 guiding center particle code has been used to study resonant magnetic perturbations (RMP) penetration and pedestal response physics in diverted DIII-D magnetic field geometry. The plasma response (including current response) to external RMPs is evaluated in XGC0 and the magnetic field perturbation, consistent with the plasma response, is calculated using a toroidal Ampere's law solver in the M3D code in mathematically strong coupling. Monte Carlo neutral atoms, kinetic ions, kinetic electrons, heat and torque inputs are considered together. Magnetic field stochasticity and its suppression are found to be the key physics elements in understanding the pedestal transport and profile response. The simulation results are compared, with noticeable success, to DIII-D experimental results; these include radial profiles of plasma density, ion temperature, electron temperature, radial electric field, toroidal rotation, and electron perpendicular flow. Comparison of the results with other tokamaks (especially, the tight aspect ratio devices NSTX and/or MAST) is to be performed and presented. A new understanding of RMP field penetration physics and the stochastic plasma transport physics has emerged from these simulations. Similarities with and differences between ideal and resistive MHD results will be discussed. Future plans for further validation in ASDEX-JET and for predictive ITER simulation will also be discussed.

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