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Numerical study of kinetic edge transport in the presence of resonant magnetic perturbations

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XGC0 kinetic neoclassical edge particle code is used to study the RMP transport physics in a DIII-D low collisionality edge, with the physical region spanning from the edge of the core plasma, across the pedestal and separatrix, to scrape-off region, and to the material wall. The present simulation can include the self-consistent combined effects of neoclassical and stochastic processes induced by the external RMP field. At the present time, only the vacuum RMP is added in the geqdsk magnetic data. XGC0 finds that the basic electron transport mechanism under RMP is much different from the conventionally assumed Rechester-Rosenbluth mechanism due to several nonideal effects such as incomplete phase space stochasticity, magnetic mirror force, self-consistent ambipolar radial electric field, etc. Ambipolar particle transport is found to be significantly enhanced by RMP. The heat out-flow from the core plasma can keep the pedestal temperatures up. However, the lack of particle out-flow from the core plasma makes the pedestal density to drop significantly (neutral in-flux from the wall cannot support the pedestal density in the presence of RMP enhanced particle transport). Bootstrap current can be reduced by RMP to a level below the conventional axisymmetric neoclassical level. It is also found that RMP enhances the plasma rotation into the co-current direction. Detailed understanding of the fundamental RMP-driven transport physics will be presented, together with a validation study against some published DIII-D RMP data, in collaboration with the DIII-D team.

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