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Kinetic simulation of 3D magnetic field perturbation effects on pedestal and ELM

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It has been well known from experiments that an external-coil-driven 3D magnetic field perturbation, such as toroidal ripple [JT-60 and JET] or stochastic field [DIII-D][1], can affect pedestal profiles and ELM instability. Even though this phenomenon is most likely to be from kinetic effects, an adequate first principles kinetic study has not appeared in the literature due to lack of a kinetic code which can handle the separatrix region. In order to perform such a kinetic study, we upgraded the original XGC-0 code, which was a full-f neoclassical ion guiding center code, to include the electron dynamics by using the logical sheath method in the scrape-off layer. The upgraded edge kinetic particle code XGC-0 will be used to examine the effect of the externally driven 3D magnetic perturbations on the pedestal transport property, which will influence the pedestal height/shape. The M3D will then be used to study the resulting impact on the ELM instability, in connection with XGC-0. Toroidal field ripple affects the pedestal/ELM through the ion channel (non-ambipolar ion ripple transport). On the other hand, the stochastic magnetic field affects the pedestal/ELM firstly through the electron channel to modify the radial electric field, which then modifies the ion orbital topology and non-ambipolar plasma transport. Comparison with experimental results will be attempted, and relevant experimental measurements will be discussed.

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[1] T.E. Evans, R. Moyer, et al., Phys. Rev. Lett. **92**, 235003 (2004)