

Coupled Kinetic-MHD Simulations of ELM Effects on Divertor Heat Loads

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The behavior of divertor plate heat load profiles during discharges with Type I ELMs is under investigation in present-day tokamak experiments such as DIII-D [1] and NSTX [2]. These studies have key implications for the ability of the ITER divertor to withstand peak energy fluxes driven by large individual ELMs and the accumulated heat load and surface ablation. We present here simulations of ELM activity and associated divertor heat loads in which we couple the discrete guiding-center neoclassical transport code XGC0 [3] with the nonlinear extended MHD code M3D [4] using the End-to-end Framework for Fusion Integrated Simulations, or EFFIS [5]. In these simulations, the kinetic code and the MHD code run concurrently on the same massively parallel platform. Periodic data exchanges are performed using a memory-to-memory coupling technology provided by EFFIS. XGC0 starts from the equilibrium reconstruction of a specific discharge, just before the onset of a Type I ELM. M3D models the fast ELM event and sends updates of the magnetic field perturbations to XGC0, which in turn tracks ion and electron dynamics within these perturbed fields and collects divertor particle and energy flux statistics over several time intervals before and during the nonlinear ELM. Magnetic field updates are performed on the Alfvén time scale, allowing us to track ELM effects on the time history of divertor heat loads. We report here how EFFIS technologies facilitate these coupled simulations and discuss results for a selection of discharges from the 2010 JRT studies.

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[4] W. Park et al, Phys. Plasmas, vol. 6, p. 1796 (1999).

[5] J. Cummings et al, Proceedings of the 18th Euromicro Conference on Parallel, Distributed and Network-based Processing (PDP 2010).