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P1.1059 Non-linear MHD Simulations of ELMs in a Detached Divertor

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ITER plasmas will be characterized by a high density plasma (i.e. Greenwald fraction) at low collisionality inside the separatrix, a high density in the scrape-off layer combined with a high recycling detached divertor. ELMs in ITER are expected to be tolerable at low plasma current but need to be controlled at the full 15MA current. Whether ELMs are tolerable depends in part on the interaction of the ELM energy and density losses with the detached divertor, i.e. do (very) small ELMs burn through the detached divertor plasma. Since the ITER regime cannot be obtained in current experiments, i.e. numerical simulations of ELMs are required for the extrapolation to ITER.
To improve the modelling of the divertor in the non-linear MHD code JOREK, a description of neutrals and impurities have been implemented. Previously, the neutrals have been modelled as a fluid. Recently, the JOREK code has been extended to include a kinetic (i.e. particle) description of neutrals and impurities [1]. Both neutrals and impurities are followed as discrete particles in the JOREK finite element grid. Ionisation and recombination lead to sources and sinks for plasma density and neutrals and to changes in charge state of the impurities. Radiation is included for both neutrals and impurities. Using the binary collision model for the impurities, the thermal force, leading to a flow of impurities up the temperature gradient, is taken into account. Multiple species of impurities, of arbitrary (time varying) charge state, can be included. The sputtering of impurities, by the main plasma, by self-sputtering or by other impurities has been implemented and verified. The sputtering model includes the prompt redeposition, particularly important for heavy impurities such as Tungsten. As a first application, ELMs are simulated in ITER plasmas on a domain extending up to ITER first wall panels and the divertor.

[1] D.C. van Vugt, Kinetic modelling of ELM-induced tungsten transport in a tokamak plasma, submitted

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