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TH/2-1: Non-linear MHD Modelling of Rotating Plasma Response to Resonant Magnetic Perturbations

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The application of Resonant Magnetic Perturbations (RMPs) demonstrated the possibility of total Type I ELM suppression or strong mitigation of the ELM size in many experiments motivating to use this method on ITER, where Type I ELMs represent a particular danger for Plasma Facing Components (PFC) and divertor materials. In the present work the rotating plasma response to RMPs was studied using the non-linear resistive reduced MHD codes: RMHD in cylindrical geometry and JOREK in toroidal geometry including X-point and Scrape Off Layer (SOL). For this purpose the RMHD and JOREK codes were further developed to include RMPs physics, toroidal rotation source, neoclassical poloidal viscosity to describe poloidal rotation dynamics and, finally, two fluid diamagnetic effects. The equilibrium plasma flows, essential for RMP screening, were studied in toroidal geometry with X-point using JOREK code. It was demonstrated that in toroidal plasma the parallel equilibrium flow is mostly constrained by the toroidal rotation source in the core region. However in the SOL and near the separatrix equilibrium flows result essentially from the combination of sheath boundary conditions for parallel velocity on the divertor plates, toroidal curvature effects, X-point configuration, neoclassical poloidal viscosity and diamagnetic and drifts. Usually screening of central islands induced by static RMPs was obtained both in cylindrical and toroidal geometry in plasma with flows. However, at certain plasma parameters or due to the non-linear evolution of the radial electric field produced by RMPs, the poloidal rotation can be compensated by the electron diamagnetic rotation locally. In this case RMPs can penetrate. At certain plasma parameters coupling of RMPs to the intrinsic MHD mode localized at the plasma edge was observed in modeling in toroidal geometry with X-point. Typical JET-like equilibrium, plasma parameters and RMP spectrum generated by external EFCC at $n=2$, 40kAt were used in JOREK modelling. Initial modelling results of RMPs with non-linear MHD rotating plasma response will be presented for ITER parameters.

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