Dynamics of pedestal profiles in ELMy H-mode plasmas in TCV at different collisionalities

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The time evolution of the spatial profiles of electron density and temperature has been analyzed during quasi-stationary H-mode phases in TCV with different types of ELMs. Increasing the heating power via ECRH at the 3rd harmonic, the edge collisionality parameter could be changed from 0.8 to 0.4, leading to a change in ELM behaviour from type-III to type-I. The profiles in the pedestal region were measured by Thomson scattering, taking advantage of an improvement in its spatial resolution. Random sampling and coherent averaging of data sets collected from a series of reproducible shots was used to reconstruct the time evolution during the ELM cycle with an effective sub-ms time resolution. After fitting of the pedestal profiles by an analytical function, a reduced set of parameters is obtained, which characterizes the pedestal and allows a comprehensive description of its time evolution. The variation of pedestal height, width, and maximum gradient for density and temperature profiles are compared for cycles with ELMs of type-III and type-I and characteristic differences are revealed.

The measured profiles of electron pressure have been used, together with a consistent plasma equilibrium description, as input for MHD stability calculations (KINX code). The results served as basis for the analysis of the profile dynamics, assuming that pedestal pressure and maximum pressure gradients are constrained by MHD stability limits. At the higher collisionality and ELMs of type-III, the stability limits appear to be set by pressure driven high-n ballooning modes, whereas at the lower collisionality and type-I ELMs, external kink modes at medium n-numbers are most relevant. The time evolution of the pressure and current density profiles have been simulated with the ASTRA code. It is shown that transport is strongly affected by the width of the zone occupied by the MHD mode. The simulations also describe the rapid recovery of the edge pressure after the ELM-induced collapse.

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