

P2.1088 A 6-field fluid model for the study of turbulence-driven magnetic islands and impurity transport

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Transport in a Tokamak is caused by several mechanisms. While at the plasma edge turbulent transport dominates, neoclassical transport is important in the core region especially for heavy impurities [1]. Furthermore, large-scale MHD instabilities like magnetic islands are known to influence the transport of heat, particles and impurities. It is insufficient to study these mechanisms independently, since the development of a magnetic island may be heavily influenced by small-scale turbulence as well as by neoclassical effects.

Therefore, we want to describe magnetic islands, turbulence and neoclassical physics in one model. We derive a new six fields model describing magnetic flux ψ , vorticity ω , ion and electron temperatures T_i , T_e , density n and parallel velocity u_{\parallel} evolutions. This allows for the modelling of tearing modes as well as interchange and ITG turbulence. We model neoclassical physics by introducing an adequate closure relation on the pressure anisotropy, following [2]. We have implemented this model into AMON code [3]. This is a parallelised semi-spectral code that can evolve the fluid equations on large grids efficiently and which allows to study, both, large-scale MHD phenomena and small-scale turbulence self-consistently.

Our simulations focus on the situation where the tearing modes are linearly stable and a magnetic island grows due to nonlinear effects. First, we present the generation of a small magnetic island from turbulence [4-5] and the role of neoclassical physics in the process. We observe that while the initial growth rate of the magnetic island is imposed by the turbulence, its subsequent growth is strongly enhanced by neoclassical physics, leading to neoclassical tearing modes (NTMs). Second, we study the dependence of the saturation size of an NTM on the level of ITG turbulence present in our simulation. Finally, we discuss the potential impact of magnetic islands in interaction with turbulence on transport and the future extension of our model to describe the transport of heavy impurities.

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