NONLINEAR GYROFLUID SIMULATIONS ON THE MAGNETIC FIELD STRUCTURE OF IDEAL BALLOONING ELMS

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Edge localised modes (ELMs) of type I are usually explained by the onset of ideal (peeling-)ballooning modes in the edge pedestal of H-mode plasmas. This work presents nonlinear gyrofluid simulations on the magnetic field structure resulting from such a magnetohydrodynamic ELM blowout.

The presented simulations are performed within the nonlinear gyrofluid model GEMR, developed by B.D. Scott [1]. GEMR is based on the construction of moments from the gyrokinetic equation and evolves the gradients in density and temperature as part of the dependent variables. Moreover, the model includes the computation of a time-dependently self-consistent, circular-toroidal magnetic equilibrium [2].

The simulations illustrate the temporal evolution of an ideal ballooning mode (IBM) instability from an artificially prepared, ideal-ballooning unstable H-mode state. The plasma parameters are based on experimental values for the ASDEX Upgrade H-mode pedestal [3].

The linear growth phase of the IBM instability is shown to be characterised by a pronounced parallel mode structure giving rise to the formation of magnetic islands. Due to several closely located resonant rational surfaces, neighbouring chains of islands are found to overlap already during the linear growth phase. The resulting magnetic stochasticity is shown to increase until the instability reaches nonlinear saturation. After the IBM blowout, the system passes into an L-mode like, turbulent state, which is observed to sustain large magnetic perturbations. Since a satisfactory theoretical understanding of the L-H transition is still lacking, the expected renewed transition into an H-mode like state can not be simulated self-consistently.

The effects of externally applied resonant magnetic perturbations (RMPs) will be included as well. RMPs will be modelled by adding a specified magnetic potential with 3 helicity components satisfying zero additional current [4].