# Effects of the electrostatic shear on the edge plasma in a two-field – like model implemented in the transport code SOLEDGE2D-EIRENE

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# Effects of the electrostatic shear on the edge plasma in a two-field $\kappa - \epsilon$ like model implemented in the transport code SOLEDGE2D-EIRENE

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Spontaneous generation of transport barriers at the edge of magnetically confined plasma characterizes the so-called high-confinement mode, or H-mode, in which it has been observed that the structure of the potential induces a strong $E \times B$ velocity shear that may explain a reduction of the turbulence [1]. This contribution aims to 1) introduce the description of such shearing phenomena in a 2D $\kappa$-$\epsilon$-like reduced model for edge plasma turbulence, inspired by the RANS (Reynolds Averaged Navier-Stokes) approach, 2) define and investigate the model free parameters and 3) study the implications on plasma properties by implementing the model in a transport code. In this $\kappa - \epsilon$ approach, a dedicated equation describes the evolution of turbulence energy, akin to $\kappa$, and its non-linear self-regulation mechanism. A second equation on $\epsilon$ introduces a turbulence regulating field driven in particular by $E \times B$ shear flows. More precisely, the electrostatic potential being self-consistently calculated solving current equation, one finds that the radial electric field is proportional to the opposite of the ion pressure gradient in the closed field line region (force balance) and roughly proportional to the gradient of electron temperature in the scrape-off layer (boundary condition on the parallel current). This implies a strong $E \times B$ shear at the separatrix driving the growth of $\epsilon$ and potentially a suppression of the turbulence energy. Ultimately, the reduction of $\kappa$ leads to a strong pressure gradient of ion pressure re-enforcing the $E \times B$ shear and stabilizing the onset of a transport barrier as can be found in [2].
The $\kappa - \epsilon$ model is implemented in the transport code SolEdge2D-Eirene and 2D diffusivities maps are computed hence fully constraining transport properties for given plasma scenario. The free parameters of the model are defined comparing SolEdge2D-Eirene simulations with experiments. Then power ramps are simulated and the possibility to recover flavors of the L-H transition with the reduced $\kappa - \epsilon$ turbulence model is discussed.

[1] J. W. Connor et al., Plasma Phys. Control. Fusion 42 (2000) R1–R74.

[2] K. Miki, P. H. Diamond, O. D. Gurcan et al., Phys. Plasmas 19, 092306 (2012).