Integration of pedestal reduced models in time-dependent simulations

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Predictions of plasma performance and alpha power for ITER have indicated that the pedestal structure can significantly affect the operational regime. Simulations conservatively assume an upper limit to the pedestal height in ITER based on peeling-ballooning stability limits; the presence of ELMs would then reduce this limits.
As part of an ITPA activity within the IOS group, a lookup table of EPED1 [1] calculations has been developed using OMFIT [2] for integration in time-dependent simulations. The calculations have been run for the ITER operational scenario from half-field and half-current to full-field and full-current and include about 8500 cases for hydrogen, helium, deuterium and a mix of deuterium and tritium. Pedestal height and width are interpolated over the six input parameters during the simulation and the pedestal adjusted accordingly.
The lookup table is being complemented with a multivariate parametrization, which is easy to implement in a time-dependent simulations, and plans for future development include a neural network based on NEUPED [3].
The idea being this activity is to have modelers to use the same boundary conditions for ITER simulations.
Challenges in the time-dependent integration include (a) sensitivity to the radial grid resolution (b) an additional degree of freedom when both density and temperature are predicted (d) integration with core transport.

Validation is an important part of all modeling activities and we plan on extending the EPED1 calculations to operational regimes on present day tokamaks. Using TRANSP as the time-dependent transport solver and including a neural network for the pedestal that can be run on experiments, this project would provide a powerful tool to assess limits of existing approaches based only MHD stability, as well as provide an extended database for modelers to advance our understanding of the pedestal structure.

[1] P.B. Snyder et al NF 51 103016 (2011).
[2] O.Meneghini et al., NF 55 2015
[3] O.Meneghini, this workshop

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