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Flux driven pedestal formation in tokamaks: Turbulence simulations validated against the isotope effect

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Flux driven pedestal formation in tokamaks:
Turbulence simulations validated against the isotope effect

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Spontaneous pedestal formation above a power threshold at the edge of magnetically confined plasma is modelled for the first time in flux driven three-dimensional fluid simulations of electromagnetic turbulence with the code EMEDGE3D [1]. The model implemented in EMEDGE3D is based on nonlinear fluid equations for the charge, energy balance and Ohm's law, the three transported fields being the electrostatic potential, the electron pressure and the magnetic potential [2].
Three key ingredients of the edge turbulent transport are simultaneously included in the flux driven simulations, applied on realistic L mode edge parameters, namely:
- an edge turbulence modelling accounting for resistive ballooning modes as well as drift waves [3,4,5,6]
- the electromagnetic effects on edge turbulence [3,4,5,6]
- a force balance radial electric field accounting for a realistic neoclassical poloidal velocity profile, i.e. with a realistic L mode edge radial variation of collisionality (from banana to Pfirsch-Schlüter regimes) [7,8]
The existence of a threshold on the injected power above which a pedestal forms is recovered. The pedestal formation is shown to be due to the E×B shear of the turbulence, following the BDT criterion [9]. The neoclassical friction and the Reynolds stresses are of the same order, while the Maxwell stress is negligible.
![Time and radially averaged (over 0.86

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