Determination of edge boundary conditions in JET ELMy H-mode plasmas by means of EDGE2D modelling

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In predictive transport modelling, the separatrix density and temperature specified as boundary conditions can strongly influence the simulation results, such as confinement and ELM behaviour [1]. This becomes a concern, as the combined uncertainty in magnetic reconstruction and diagnostic position result in an uncertainty in the mapping of the density and temperature profiles in JET of at least 1 cm. Given the strong gradients in the edge pedestal of H-mode plasmas, with scale lengths comparable to the uncertainty in the mapping, this translates into considerable uncertainty in the separatrix density and temperature. In line with other similar studies [2, 3, 4], the purpose of this work is to provide better estimates for the separatrix boundary conditions.

In this study, the quasi-stationary inter-ELM H-mode phases of a number of well-diagnosed JET plasmas are modelled with the two-dimensional edge transport code EDGE2D/EIRENE. In the EDGE2D/EIRENE coupling, EDGE2D solves the fluid equations for the conservation of energy, particles and momentum, whereas the kinetic neutral Monte Carlo code EIRENE provides the source terms of the fluid equations due to plasma-neutral interactions. By adjusting the model parameters for perpendicular transport in the core, edge transport barrier and scrape-off layer regions of the simulation domain, the EDGE2D/EIRENE simulations are matched with experimental data for each shot. Specifically, the simulations are compared against high-resolution Thompson scattering data for the electron temperature and density at the outer midplane and against infrared camera and Langmuir probe data for the divertor heat and particle loads. Due to the uncertainty in the separatrix position with respect to the experimental data, one usually ends up with a radial shift between the simulated and experimental profiles, whereby the emphasis has to be on matching the top of the pedestal and the gradients. The comparison of the simulations with the measured data, including the aforementioned uncertainties, is implemented using a probabilistic approach. This makes it possible to assess the quality of the profile match in a more rigorous way than when resorting to manual shifting of the profiles. Predictions for the separatrix temperatures and densities can then be taken from the simulations, where the separatrix location is defined. A range of JET discharges forming scans in power and edge safety factor q_{95} are modelled. The density and temperature variations at the separatrix are studied as a function of power and q_{95}. The aim is to derive a simple parameterization for the separatrix boundary conditions.

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