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Statistical validation of transport models on baseline discharges in preparation for the extrapolation to JET D-T

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The EUROfusion Consortium is planning deuterium-tritium (D-T) experimental campaigns in 2019 on JET with the ITER-Like Wall (ILW) to address physics issues which are important for ITER-D-T experiments. To achieve the scientific objectives, JET operation should demonstrate 10-15MW of fusion power for at least 5 seconds, a performance never attempted before in fusion-research history. The preparation of the D-T campaign requires, therefore, reliable predictive simulations of this unprecedented JET operational scenarios, providing assessment of the impact of uncertainties resulting from operating with an ILW such as degraded edge confinement and core tungsten accumulation, and from operating with a D-T mixture such as isotopic effects on stability and confinement and alpha heating.

Despite the remarkable improvements in present core transport models such as GLF23 and TGLF, the current ability to predict plasma temperature evolution and the resultant fusion power is still limited due to the incompleteness of first principles theories of energy and particle transport in turbulent thermonuclear plasmas and the uncertainty of input data required for predictive simulations such as pedestal temperature, Zeff, and rotation profiles. Thus, for a quantitative assessment of the uncertainties in the D-T performance with ILW, statistical validation of predictive simulations with a large database of D-D discharges is of crucial importance.

Predictive TRANSP simulations with advanced transport models such as GLF23 and TGLF for JET experiments is now available using automated input data preparation routines, the JET-TRANSP scripts, which enables one to carry out a large number of predictive TRANSP simulations. In this paper, statistical assessment of the level of agreement of predictive TRANSP simulations with the GLF23 transport model carried out on a large set of well diagnosed JET baseline discharges will be presented, and sensitivity studies on uncertain parameters such as pedestal Ti, Zeff, and rotation profiles will be discussed. The assumption used in the simulation is further investigated for a few representative discharges with the TGLF transport model, which is computationally expensive but more accurate than GLF23. This statistical validation with the assessment of uncertainty level will constitute the basis for TRANSP predictions of JET-ILW-DT experiments.

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