Validation of TGLF predictive capability on baseline high performance JET Deuterium plasmas and extrapolation to DT.

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One of the key aspects for future fusion reactors is the understanding of plasma behaviour with different hydrogen isotopes, the so called isotope effects. Since 80s, experimental and modelling efforts have been dedicated to understand the isotope effects. The upcoming JET-DT campaign gives the unique opportunity of comparing and validating the state of the art of modelling tools with fusion relevant DT plasmas. To prepare the 2021 JET-DT experimental campaign and to predict the plasma performance, an extensive modelling activity has been carried out. This work reports about the validation of the TGLF transport model: several Deuterium (DD) high performing baseline discharges have been analysed by running TRANSP integrated modelling simulations with a couple of saturation rules in TGLF (SAT1 and SAT1geo). In particular SAT1geo has been modified with respect to SAT1, with the effect of increasing the ion stiffness and reducing the ExB stabilization, generally predicting higher fluxes and hence milder profiles. The discharges included in the analysis have plasma current from 3.0 to 3.4 MA, B_t = [2.8-3.4] T and total input power P_{in}=[26-34] MW, with steady state high neutron rate phase lasting for several energy confinement times. For each discharge, the content of each impurity and the radiation profile have been measured by soft-X ray analysis, including Be, Ne, Ni and W. Also the rotation profile is input in the model, whereas electron density n_e, temperature T_e and ion temperature T_i are predicted.

The work aims at identifying the model capability of matching the experimental T_e, n_e and T_i profiles in the core and confinement regions, ρ=[0,0.8]. Also the temporal evolution of absolute value of neutron rate and line integral density has been included in the analysis, to consider volume effects. After an initial tuning of TGLF, no modifications at the transport model settings have been applied, apart from the saturation rule in TGLF. In general the profiles and neutron rates predicted with SAT1 show a better agreement with experimental data, whereas SAT1geo obtains a good match only in some specific time interval, in particular with the n_e profile. The temporal trends of global quantities are well reproduced, but a negative offset (decrease in performance) is often predicted by SAT1geo at the beginning of the profiles prediction, suggesting an overestimate of the predicted fluxes with respect to the experimental ones. On these bases, the saturation rule SAT1 has been selected to extrapolate DD baseline plasmas to DT, resulting in about 10 MW of fusion power at P_{in}=33MW and about 14MW at P_{in}=40MW.