

Edge and divertor modelling of JT-60SA ITER-like scenario with carbon wall

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The main objective for JT-60SA is to study magnetically confined plasma in near-fusion scenarios in support of ITER and DEMO. One of the major open issues is to demonstrate divertor heat and particles handling in ITER-like plasma conditions. One of the options for JT-60SA divertor in the Integrated Research phase II is to use Tungsten as plasma facing component[1], while in the initial research phase it will be equipped with full carbon walls. JT-60SA ITER-like scenario is an inductive single null divertor configuration with 41MW of input power, the maximum available for the machine, and presents the major challenge in terms of power handling because of its low density at the separatrix $n_e = 1 \times 10^{19} m^{-3}$ [1]. Similar studies have been made for lower input power JT-60SA scenarios [2], while the 41MW scenario has been simulated with higher densities with the integrated divertor simulation code SONIC[3].

JT-60SA full carbon divertor mono-block allows heat loads up to $15MW/m^2$. Edge modelling by means of coupled plasma-neutral codes is needed to predict what operational regimes can be handled by the divertor: such codes indeed are the most reliable to calculate particle and heat transport in high recycling and detachment conditions. SOLEDGE2D-Eirene is particularly suitable for this case for its ability in describing plasma-wall interaction for the proposed magnetic configurations. By means of SOLEDGE2D-EIRENE, in this work, we have evaluated if, for the JT-60SA high power low-density scenario, the radiation fraction foreseen in the SOL (higher than 85% [1]) is achieved by the intrinsic carbon impurities and the corresponding core contamination. We have also studied the effect of additional seeded impurities, and whether they can provide an advantage in respect of the pure deuterium solution.

In order to define reasonable transport parameters for modelling, we have considered JET pulses with carbon wall and with global parameters (such as heating power, n/n_G , n_{core}/n_{sep} , plasma shape and strike point positions) as much close as possible to those of the analysed scenario. Edge transport parameters have been evaluated in such compatible condition by comparing SOLEDGE2D-EIRENE results to experimental data from spectrometers, Langmuir probes and Thompson scattering. The model has then been applied to JT-60SA scenario. With such a model, the edge plasma parameters of scenario have been estimated, the heat load to the divertor and the impurity influx needed to reduce the heat flux to the divertor under steady-state conditions have also been calculated.

[1]JT-60SA Research Plan: http://www.jt60sa.org/pdfs/JT-60SA_Res_Plan.pdf

[2]M.Romanelli et al., Investigation of Sustainable Reduced-Power non-inductive Scenarios on JT-60SA, (2017)

[3]H.Kawashima et al., Evaluation of heat and particle controllability on the JT-60SA divertor, J. Nucl. Mater. 415 (2011)

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