# SIMULATIONS OF THE SOL PLASMA FOR FAST, A PROPOSED ITER SATELLITE TOKAMAK

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The plasma-wall interaction is one of the most outstanding issues for ITER and in view of DEMO. One of the objectives of the proposed FAST tokamak is to investigate this issue in an ITER relevant regime. The main parameters of FAST are : R=1.82m, $B_T$ up to =8.5 T, $I_p \leq 8$ MA, $P_{add}$≈30÷40 MW (P/R≤22). Even if FAST will be mainly in support of ITER operations, it also aims to investigate some technical issues relevant for DEMO, in particular in view of a full W wall and divertor and possibly even a liquid metal (Lithium) as divertor target. For a consistent design it is necessary to have a reliable estimate of the thermal loads on the divertor targets by predicting the SOL behaviour for the different FAST scenarios. Having done already a first general evaluation of the edge plasma with a self-consistent edge-core code COREDIV [1], a more detailed analysis is now being carried out with the main aim to optimize the divertor design and to identify the conditions under which acceptable divertor load are attained. Particular attention is given to the configuration and the local conditions that can favour the plasma detachment from both outer and inner targets. Simulations for the present paper have been performed mainly with EDGE2D/EIRENE, and we will report also on first results from SOLPS. Numerical investigations with EDGE2D/EIRENE have been done by scanning in various parameters. We have performed scans in the value of the ion density at the outer midplane, with $n_{s,out}=0.7$ to $1.5\cdot 10^{20}$ $m^{-3}$ : this range covers the interval for the FAST scenarios, which are foreseen to have an average density varying from 0.8 to $5\cdot 10^{20}$ $m^{-3}$. Scans have also been performed in the perpendicular transport for energy and particles values and in pump efficiency. Also different bulk radiative losses and impurity seeding have been considered. Preliminary results show that in general semi-detachment or detachment in the inner divertor is more easily attained than in the outer divertor. For the highest density ( $\bar{n}_e$>=$4\cdot 10^{20}$ $m^{-3}$) the simulations show that detachment might be attained on both inner and outer targets even with no impurity and relatively low radiation losses, but the intermediate density regimes require an increase in the SOL and bulk radiation loss in order to develop a semi- to fully-detached plasmas and to alleviate the thermal load on the outer target. Simulations show also that with the highest input power (>30 MW) it is difficult to achieve total detachment. The present simulations indicate that injecting impurities like Ar or Ne would not greatly increase the edge radiation, probably due to the limited SOL volume available, but they could nevertheless alleviate the problem by raising the total radiation losses, confirming the evaluations predicted by COREDIV [1]. Preliminary modelling results indicate also that some margins exist for optimizing the divertor geometry and equilibrium. These issues become very important, in particular, for the quasi-steady scenario that operates at the lowest density and simulations will be presented for $n_{s,out}=0.3\cdot 10^{20}$ $m^{-3}$ which is value envisaged for steady-state scenarios.

[1] Maddaluno et al., Nucl. Fusion **49** (2009) 095011