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Particle transport and heat loads in JT-60SA studied by SOLEDGE-EIRENE code

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The JT-60SA tokamak will present the challenge of sustaining high-confinement high-density plasmas for long pulses, while protecting the targets plates. In the Initial Research Phase, JT-60SA will be equipped with a non-actively cooled C divertor, thus assessment of the heat loads at the targets in the foreseen full current inductive scenarios that would be compatible with the material limits is crucial [1].

The physics of the scrape-off layer between the plasma core and the plasma facing components then appears as critical with many fascinating open issues regarding high performance divertor operation, the physics of H-mode transport barriers and more generally, the interplay between core, edge and divertor performance. Thus safe operation of complex systems such as JT60-SA should be guided by the state-of-the-art knowledge in order to step towards novel experimental achievements.

In this context, we report recent results from the SOLEDGE3X plasma transport code coupled to the Monte-Carlo EIRENE code for neutral particles transport. Complex and realistic geometries can be handled by the code thanks to the immersed boundary condition technique (assuming axial symmetry)[2]. Therefore the influence of recycling, sputtering, neutral particles recirculation, which play a substantial role in detachment, can be addressed on a sounder basis.

SOLEDGE3X-EIRENE simulations, both in pure deuterium plasmas and taking into account C sputtering, with the available auxiliary heating power P_{aux} in the range 15-30 MW are presented for the fully inductive scenario#2 [3]. The influence of the SOL width on the wall heat loads at the targets as well as in the main chamber is explored for a set of several different cross-field diffusion coefficient profiles in the SOL. The results in Figure 1 illustrate (in agreement with previous research [4,5,6]) that even for the lowest P_{aux} case C radiation is not enough to bring the local heat load below 10 MW/m^2 (maximum for steady-state). Therefore, the possibility of Ne/Ar/Kr impurity seeding is examined. Finally, the impact of more realistic neutral pressure on the chamber heat loads and approaching detachment is assessed by using for the first time the actual JT-60SA chamber geometry with the subdivertor structure (compare Figure 1 G and H).

References

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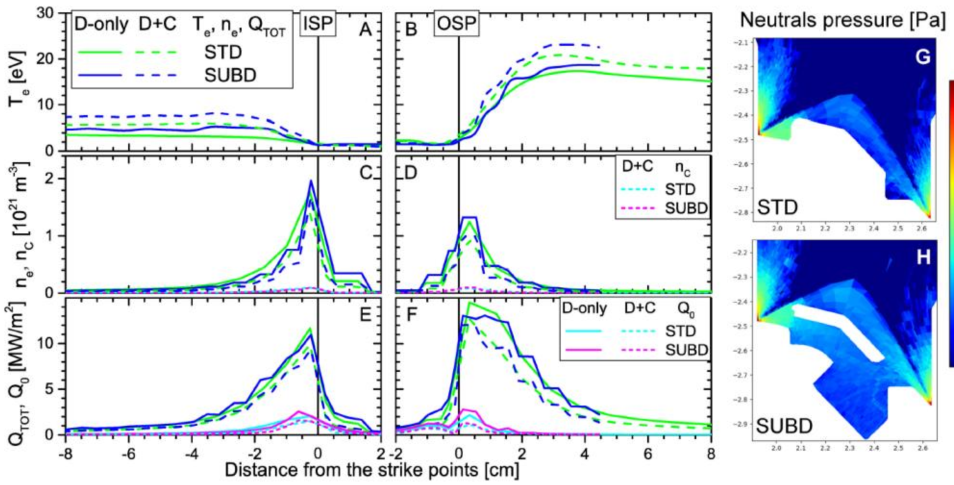

Figure 1 Inner and outer target profiles of electron temperature (A, B), electron and carbon density (C, D) and heat load including neutrals contribution (E, F) for the P_{aux}=15 MW case. (G, H) – comparison of neutrals pressure distribution in the cases with C: without (STD) and with (SUBD) the subdivertor structure.

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