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ITR/P1-27: Narrow Heat Flux Widths and Tungsten: SOLPS Studies of the Possible Impact on ITER Divertor Operation

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Recent experimental observations of a very narrow SOL for energy flow in the inter-ELM H-mode have raised a concern for the consequences for target heat loading if it were to occur in ITER. Simulations using SOLPS4.3 for a carbon divertor have shown that because of the energy dissipation by impurity radiation in the divertor, the peak divertor power load could be maintained at an acceptable level even if the SOL width were reduced down to 1 mm instead of the 5 mm resulting from current transport assumptions. In other words, partial detachment of the divertor can counteract the effect of narrowing the SOL in ITER. However, the reduced radial transport in the narrow SOL case leads to relatively high separatrix density. Whereas this should not be a problem during the burn phase in ITER, low line average densities will almost certainly be necessary to obtain an acceptably low power threshold for the L-H transition, and this may be incompatible with high separatrix density. Investigations using the integrated core-pedestal-SOL model are underway to explore the expected plasma response around the L-H transition. In this study, we initially consider a carbon divertor with two sets of boundary conditions corresponding to the wide (L-mode) and narrow (H-mode) SOL and switch between them when the core plasma matches the usual criterion for the L-H transition (the transport reduction in the pedestal area is also applied at this point).

An initial simulation study is also underway to investigate divertor performance during the burn phase in the case of W targets, using seeded Ne impurity to replace the naturally produced C radiation in the C divertor case. Since the transport and radiation properties of the seeded impurity differ from those of C, this can affect the controllability of the discharge and the divertor plasma conditions, as well as the distribution of radiative power loading on divertor components. As an example, initial modelling runs already available indicate that the radiation contribution to the peak power load on targets is lower for the W divertor than for C, since Ne radiates further upstream than C. A beneficial effect is a factor 2 reduction of the maximum radiation power loads in the gaps between the cassettes, where the heat removal can be critical.

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