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Effect of divertor performance on the pumping efficiency in DEMO

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One of the important tasks of the DEMO divertor design optimization is to ensure a desirable divertor performance and high pumping efficiency by varying, for example, the divertor dome height and pumping port position. In this paper we analyse the latest European DEMO divertor design with the pumping port located at the bottom of the divertor plenum. Optimization of the dome height and its effect on neutral compression is made by using the DIVGAS code based on the Direct Simulation Monte Carlo (DSMC) method [1]. The numerical analysis includes the calculation of neutral density in the PFR region and the overall conductance of the sub-divertor structure, which consequently affects the estimation of the effective pumping speed and the achievement of detachment. First results of density comparison in divertor operation with and without dome in divertor design with a lateral position of the pumping port were reported in [2]. It was shown that asymmetric position of pumping port relative to the gaps causes strong reflux of particles from high field side gap and in the configuration without dome from the low field side. Apart of that in the case without dome a strong neutral reflux from the private flux region was found. In the case of pumping port at the bottom of the divertor the neutral flow pattern exhibits more symmetrical distribution. It is shown that the divertor configuration with dome impedes the reflux of neutrals towards the plasma. Furthermore, in this configuration we investigate the achievements of detachment depending on the level of neutral pressure in the divertor private flux region and required throughput for actual pumping speed.

References

[1] G. A. Bird, Molecular Gas Dynamics and the Direct Simulation of Gas Flows, Oxford University Press, Oxford, UK (1994).

[2] Chr. Day, S. Varoutis, Y. Igitkhanov, "Initial studies of the divertor dome effect on pumping efficiency in DEMO", Proc. of the 26th Symposium on fusion engineering (SOFE), IEEE, US, 2015.

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