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SUB-DIVERTOR NEUTRAL GAS DYNAMICS: INTEGRATION BETWEEN THE VACUUM SYSTEM AND THE DIVERTOR OPERATION

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Over the last few years much effort has been invested in modeling the complex geometry of divertor and subdivertor region in tokamak fusion devices. The main goal is the investigation of the impact of neutral gas dynamics on the particle removal process, during operation. Depending on the plasma conditions at the divertor, the exhausted neutral gas flow is more likely to be in the continuum and slip regimes near the private-flux region and close to the divertor targets, where neutral-neutral interactions do play a vital role in the flow behavior, and then covers the transitional regime and even the free molecular (collisionless) regime in the subdivertor area. Consequently, a reliable estimate of the macroscopic parameters in such a complex system requires a tool to describe the flow in the whole range of gas rarefaction.

In the field of vacuum gas dynamics the most well-known and reliable numerical tool which is capable of simulating neutral gas flows in the whole range of gas rarefaction is the Direct Simulation Monte Carlo (DSMC) method. In this method, the solution of the Boltzmann kinetic equation is circumvented by simulating the collisions and the ballistic flight of model particles, which statistically mimic the behavior of real molecules.

Recently, a numerical tool called DIVGAS (Divertor Gas Simulator) has been developed at Karlsruhe Institute of Technology (KIT). The DIVGAS code is based on the DSMC method and is mainly focused on fusion applications. For this purpose, the DIVGAS code has been successfully validated using JET experimental results and additionally it has been benchmarked with the neutral code NEUT2D in the JT60SA sub-divertor. Both numerical investigations will be presented as indicative examples.

In view of DEMO, the DIVGAS code will be the main modelling tool, for identifying the design space of an optimum divertor geometry, which features high pumping efficiency. Representative simulations, which have been recently conducted for investigating the influence of the divertor dome on the divertor pumping efficiency, will be demonstrated.

Based on all the above, the present work describes the work flow which has to be set up by applying the DIVGAS code and in parallel highlights how DIVGAS can be successfully applied in modelling a complex sub-divertor geometry in a tokamak fusion device. Our aim is the DIVGAS code to be exploited in the sub-divertor modelling, by illustrating the use of the pumping system as an additional actuator for plasma control and divertor performance optimization.

Eligible for student paper award?

No

Author: Dr VAROUTIS, Stylianos (Karlsruhe Institute of Technology (KIT))

Co-authors: Dr IGITKHANOV, Yuri (KIT); Dr DAY, Christian (KIT, Germany)

Presenter: Dr VAROUTIS, Stylianos (Karlsruhe Institute of Technology (KIT))

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