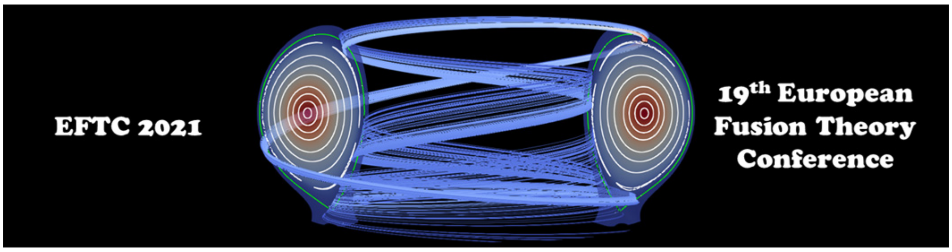

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Comparison of SOLPS-ITER and B2.5-Eunomia in the simulation of Magnum-PSI

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Understanding plasma-wall interactions produced by the huge particle and heat fluxes reaching the vessel walls in nuclear fusion devices is of uttermost importance for the next generation of reactors. For example, the divertor of ITER is expected to withstand heat loads of around 10MW m-2 in steady state operation. To recreate these conditions, the linear plasma device Magnum-PSI is currently operated at DIFFER. It allows exposing a target material to both steady state or pulsed plasma relevant for the ones expected in ITER. However, simulations are indispensable to understand the Atomic and Molecular (A&M) processes that take place in Magnum-PSI, and to extrapolate these observations to tokamak divertors. In this regard, SOLPS-ITER and B2.5-Eunomia are currently being employed to model Magnum-PSI in a wide range of parameters such as plasma current, magnetic field and plasma density. Both packages include the same CFD plasma code (B2.5) but different Mote-Carlo modules for A&M neutrals: Eirene and Eunomia, respectively. Eunomia was designed specifically for linear plasma devices like Magnum-PSI. Therefore, an effort is currently undertaken to port some of its functionality into Eirene, primarily designed for tokamaks. Although both neutral modules have similar capabilities, the implementation of some collision process lead to relevant differences. Due to the distinct multi-step implementation of Molecular Assisted Recombination (MAR) or the different collision rates used for electron impact ionization/excitation for H atoms, disparate sources of energy and particles for B2.5 are calculated by the Monte-Carlo codes. Elastic collisions of ions with molecules, although reading the same collision rate, are incorporated into the neutral codes with a distinct formulation for the an-isotropic post-collision angle, which result in different neutral distributions. B2.5-Eunomia can simulate Magnum-PSI for a wide variety of plasma scenarios. However, the lack of measured data for the potential profile at the source demands additional assumptions leading to uncertainties in the comparison. Moreover, the appropriate transport coefficients for plasma required to model Magnum-PSI are still under discussion, due to the differing from tokamaks range of plasma temperature and density in which the machine can operate. The present work is focused on code-code comparison aimed to reproduce Magnum-PSI Thomson Scattering measurements for radial electron density and temperature profiles few centimeters in front of the target. A special focus is put on how the particular implementation of different A&M processes in the two neutral modules lead to different coupled results.

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