



Contribution ID: 87 Contribution code: P2.26

Type: Poster

## SOLPS-ITER modelling of plasma rotation with co-rotating atoms in the Magnum-PSI beam

Wednesday 4 October 2023 16:16 (4 minutes)

SOLPS-ITER modelling of plasma rotation with co-rotating atoms in the Magnum-PSI beam.

H.J. de Blank<sup>1</sup>, J. Verstappen<sup>1</sup>, J. Gonzalez<sup>2</sup>, I. Classen<sup>1</sup>, E. Westerhof<sup>1</sup>

<sup>1</sup> DIFFER - Dutch Institute for Fundamental Energy Research, De Zaale 20, 5612AJ, Eindhoven, The Netherlands

<sup>2</sup> ARCNL, P.O.Box 93019, 1090BA Amsterdam, The Netherlands

In the ITER divertor heat loads of 10 MWm<sup>-2</sup> are expected in steady state. The linear plasma device Magnum-PSI [1] can achieve plasma parameters close to those expected in the ITER divertor. In particular, Magnum-PSI experiments have been made with detached plasma state. [2], a state important for the ITER-divertor by reducing heat and particle fluxes. With easier access for some plasma diagnostics in Magnum-PSI than in tokamak divertors, it is attractive to have accurate simulations of both linear and divertor plasmas with the same numerical models. The goal is to learn from the linear plasma simulations more about the atomic and molecular processes, such as reactions and excitations, relevant in detachment.

SOLPS-ITER [3] simulations of the plasma and neutral particles have been shown to be possible for the relevant regimes in Magnum-PSI [4], making use of Thomson Scattering radial profiles of electron density and temperature near the plasma source and near the target plate. The Magnum-PSI plasma source can generate significant currents throughout the plasma beam which impact the discharge through Ohmic heating. This work presents improved calculations of these currents in SOLPS-ITER by including the rotation velocity of the neutral atoms as a consequence of friction with the plasma, which rotates mainly through the ExB drift. This component of the plasma velocity, being in the ignorable (symmetry) direction and perpendicular to the magnetic field, in the standard SOLPS-ITER code is not passed on from the plasma model (B2.5) to the neutrals model (EIRENE). Including this interaction, we find that, typically, the average rotation speed of the neutral atom population is about half of the plasma rotation velocity. This co-rotation affects the entire plasma beam in two ways: by somewhat reducing the neutral density in the plasma beam centrifugally, and by reducing the radial electric resistivity through friction between the ions and neutrals.

Each simulation uses one profile of the radial electric field near the plasma source as boundary condition. This profile is based on spectroscopic measurement of the H-atom rotation velocity on 30 parallel lines of sight, using some assumptions about the kinetic neutral particle velocity distribution. This paper will verify those assumptions using information about the neutral particle velocity distribution extracted from EIRENE in a limited number of plasma locations.

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission. This work was carried out on the EUROfusion High Performance Computer Marconi-Fusion hosted at Cineca (Bologna, Italy) and on the Dutch national e-infrastructure with the support of SURF Cooperative.

References:

- [1] G. de Temmerman, et al., Fusion Engin. Design, 88, 483 (2013)
- [2] R. Chandra et al., Plasma Phys. Control. Fusion, 63 (9):095006 (2021)
- [3] S. Wiesen, et al., J. Nucl. Materials, 463, 480 (2015)
- [4] J. Gonzalez et al., Plasma Phys. Control. Fusion, 65 055021 (2023)

**Primary author:** DE BLANK, Hugo (DIFFER - Dutch Institute for Fundamental Energy Research, De Zaale 20, 5612 AJ Eindhoven, The Netherlands)

**Presenter:** DE BLANK, Hugo (DIFFER - Dutch Institute for Fundamental Energy Research, De Zaale 20, 5612 AJ Eindhoven, The Netherlands)

**Session Classification:** Poster session: 02

**Track Classification:** 7. Edge and scrape-off layer/divertor physics