Simulation study of divertor geometry for COMPASS Upgrade tokamak

I. Borodkina\textsuperscript{1,2}, A.S. Kukushkin\textsuperscript{2,3}, S. Wiesen\textsuperscript{4}, D. Boeyaert\textsuperscript{4}, M. Imrisek\textsuperscript{1}, L. Kripner\textsuperscript{1}, M. Peterka\textsuperscript{1}, R. Dejarnac\textsuperscript{1}, M. Komm\textsuperscript{1}

\textsuperscript{1}Institute of Plasma Physics of the CAS, Za Slovankou 3, 182 00 Prague 8, Czech Republic
\textsuperscript{2}National Research Nuclear University “MEPhI”, Kashirskoe sh. 31, Moscow, Russia
\textsuperscript{3}National Research Center “Kurchatov Institute”, Moscow, Russia
\textsuperscript{4}Forschungszentrum Jülich GmbH, Institut für Energie- und Klimaforschung – Plasmaphysik, Partner of the Trilateral Euregio Cluster (TEC), 52425 Jülich, Germany

borodkina@ipp.cas.cz

The development of divertor design with a reliable solution for the power and impurity particle exhaust is one of the important challenge towards the realization of the COMPASS Upgrade (COMPASS-U) project. COMPASS-U with its high plasma and neutral density is of particular interest for ITER in terms of similar divertor plasma and neutral parameters, as well as predicted power decay length and stationary power loads on the divertor targets [1]. In order to avoid overheating of the divertor plasma-facing components (PFCs), it will be essential to efficiently dissipate power in the divertor and obtain partial detachment when operating in the COMPASS-U baseline scenario ($I_p=2$MA, $B_t=5$T, $P_{in}=6$MW). Low target temperatures (5-10eV) are also required to suppress erosion of the PFCs.

In this contribution, we report on the first systematic modelling examination of the effect of different outer and inner divertor target angles, divertor closure and pump locations on the main parameters of the COMPASS-U divertor plasma. The simulations are carried out by using the 2D edge plasma code packages SOLPS4.3 [2] and SOLPS-ITER [3] for pure D plasma with fixed anomalous cross-field transport coefficients adjusted to match the power decay lengths predicted by the scaling [4]. The single-null and the asymmetric double-null magnetic configurations are used with the magnetic equilibriums produced by the FIESTA [5] code for some COMPASS-U scenarios elaborated by the scaling-law based METIS code [6]. Several divertor configurations with various target inclination angles are modelled to study the effect of divertor closure on detachment, the divertor radiated power and therefore the peak heat flux density on the divertor target. Impurity seeded cases with neon as the radiating impurity are also considered. The effect of Ne seeding, resulting in an increase of the total radiative fraction by about factor 2, on the plasma parameters and the fluxes in the divertor for different divertor configurations is presented and discussed.

The neutral gas pressure in the divertor is often considered to be a key control parameter for divertor conditions as the neutral gas in the divertor helps reaching low plasma temperatures and reducing the peak heat fluxes trough power spreading over the divertor targets. SOLPS simulations for the COMPASS-U baseline scenario are carried out with the simulation grid that includes the sub-divertor module for a more realistic evaluation of the neutral gas pressure. The effect of the cryo-pump position and the width of the gaps between the divertor tiles on the neutral gas pressure in the divertor is investigated.