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Modelling the spatial and temporal dynamics of Cs inside the BATMAN Upgrade source using the CsFlow3D code

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The production of negative hydrogen ions inside the ion sources for ITER's neutral beam injectors (NBI) takes place on a low work function large-area converter surface (plasma grid, PG). Cs is continuously evaporated into the ion-source forming a layer on the PG aiming at reducing its work function (< 2eV) in order to make the production of negative ions more efficient. However, the interaction of the plasma with the surface and the subsequent redistribution of Cs inside the source lead to a temporally unstable and inhomogeneous Cs layer. This aspect must be investigated and comprehended in order to perform long extraction pulses at ITER's requirements (several hundred s in H, 3600s in D). The Monte-Carlo Test-Particle code CsFlow3D, developed at IPP Garching, is exploited to comply with this task. CsFlow3D simulates the dynamics of Cs particles inside the pulsed plasma operating source using different input parameters such as electromagnetic fields, sticking coefficients, Cs evaporation rate, plasma-induced Cs removal rate from the surfaces, plasma density and temperature. Moreover, to interpret the results of the experimental absorption diagnostic (TDLAS), through which only the neutral Cs density along different lines of sight can be measured, a synthetic diagnostic estimating both neutral and ionized Cs densities, the latter not accessible experimentally, has already been introduced into the code. For the first time, input plasma parameters obtained from a 2D fluid code, realistic oven nozzle geometries and time/space-dependent surface parameters (e.g. sticking coefficients and plasma-induced removal rate of Cs from the surface) are adopted for the code. This contribution presents results investigating the influence of the new input parameters on the Cs redistribution and the respective validation against the experimental results for the BATMAN Upgrade source in hydrogen.

Primary author: MUSSINI, Daniele (Max-Planck-Institut für Plasmaphysik)

Co-authors: WIMMER, Christian (Max-Planck-Institut f. Plasmaphysik); WÜNDERLICH, Dirk (Max-Planck--Institut für Plasmaphysik); Mrs FANTZ, Ursel (Max-Planck-Institut für Plasmaphysik)

Presenter: MUSSINI, Daniele (Max-Planck-Institut für Plasmaphysik)

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