Validation of EDGE2D-EIRENE and DIVIMP for W SOL transport in JET

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Tungsten sputtering and density profiles predicted using the edge plasma codes EDGE2D-EIRENE [1,2] and DIVIMP [3,4] are found to agree within a factor of 2 with measurements of neutral and singly-ionized W spectral line emission in the JET low-field side (LFS) divertor, and with SXR, VUV, and bolometric estimates [5] of the W density in the main plasma. The studied plasmas include low-recycling L-mode and high-recycling H-mode conditions typical for JET.

To reproduce the spectroscopically inferred W sputtering rates in EDGE2D-EIRENE, imposing the experimentally observed Be concentration of the order of 0.5% [6] in the divertor is necessary. Using EDGE2D-EIRENE to model the intrinsic Be sputtering and transport results in an underestimation of the Be concentration by more than a factor of 10 in the LFS divertor and at the HFS strike point.

Even though most of the W erosion in L-mode and inter-ELM H-mode occurs at the divertor targets due to Be ions, the predicted W density in the main plasma was found to be insensitive to whether or not the simulated Be concentration is consistent with experiment. This is because almost all of the W sputtered near the strike points is redeposited without reaching the main chamber. Instead, the vast majority (90-99%) of the predicted core W originated from sputtering due to fast D charge-exchange atoms at the W-coated tiles above the LFS divertor.

The observed and predicted plasma conditions in the divertor are consistent with each other only when cross-field drifts are included in the H-mode simulations. Accounting for drifts and toroidal rotation is also essential in both the L-mode and H-mode simulations for code-experiment agreement regarding poloidal W asymmetries (up to one order of magnitude) in the edge region of the confined plasma.

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