An exploration of a low temperature regime in EDGE2D-EIRENE simulations of JET ITER-like wall L-mode discharges

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JET with its ITER-like wall (ILW) of Be in the main chamber and W in the divertor is ideally suited to gain understanding of the behaviour of the plasma edge and divertor, which is essential for predicting the performance of next-step machines such as ITER. Simulations by Groth *et al.* [1] of L-mode discharges run during JET-ILW campaigns and the previous JET-C campaigns, in which the plasma-facing surfaces were predominately C, have consistently shown a shortfall in the radiated power below that measured by bolometry, this bringing into question the predictions for the radiated power and cooling of a radiative divertor in a next step-machine. A similar result is found for unseeded ELMy H-mode discharges by Järvinen *et al.* [2]. A series of JET-ILW L-mode discharges, which reach detachment, provide a stringent test of the simulations in that most (~90%) of the radiated power from the divertor is due to atomic and molecular D, with impurities only playing a small role. In EDGE2D-EIRENE simulations, the molecular contribution is, typically, only ~10-15% and these results suggest that the simulated T_e is too high throughout the divertor volume, in particular not reaching the very low T_e (~1eV) required to give significant atomic D radiative recombination and high molecular densities with their associated power losses, this being especially so near the inner divertor target [3]. To test the sensitivity of the simulated temperature to the atomic and molecular power loss terms, these were artificially varied. A sensitivity to small changes (a few per cent) in the atomic power loss term, within the expected accuracy of the controlling atomic physics, was found to lead to a step down or transition in the temperature with increasing power loss [4]. This low temperature regime is explored by determining the temperature sensitivity to the power losses within particular temperature ranges. To understand better the acceptable variation of the D emission at different temperatures a reassessment of the D atomic data has been carried out, in particular to determine the likely accuracy of the data relating to collisional excitation, ionization and recombination. When combined with recently completed sensitivity calibrations for a VUV survey and a poloidally scanning VUV spectrometer [5] they will enable line-of-sight measurements of D line emission and consequently the power radiated by D to be estimated. The use of ratios of the line emission from low n shells, which measured along a divertor view are experimentally found to be independent of temperature, together with the absolute measurements of the D radiation and line intensities will be used to guide the simulations in order to achieve a more satisfactory agreement with the bolometric measurements of radiated power.

[1] Groth *et al.*, 2013, Nuc. Fus., **53**, 093016

[2] Järvinen *et al.*, 2015, JNM, **463**, 135

[3] Lawson *et al.*, 2015, JNM, **463**, 582

[4] Lawson *et al.*, 2017, NME, **12**, 924

[5] Lawson *et al.*, 2012, Rev. Sci. Instrum, **83**, 10D536

See the author list of X. Litaudon et al., 2017, Nucl. Fusion, **57, 102001*