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Hydrogenic atomic and molecular emission measurements in JET-ILW for assessing the role ion-molecular interaction in divertor detachment

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Detailed comparisons of measured and predicted plasma conditions at the divertor plates, and atomic and molecular hydrogenic emission across have been carried out with the edge fluid codes EDGE2D-EIRENE and SOLPS-ITER for low-confinement mode plasmas in the JET ITER-like wall materials configuration with its tungsten divertor. In deuterium plasmas and low-recycling scrape-off layer plasma conditions, EDGE2D-EIRENE predicts the measured plasma conditions, the total radiated power and the deuterium Balmer line emission to within 20%, thus well within the uncertainties of the measurements. In plasma conditions representing the onset of divertor detachment, EDGE2D-EIRENE predicts that the reduction in the total ion current to the target plates is produced by an exponential increase in the predicted molecular density at the low-field side target plate, leading to plasma pressure losses predominately due to ion conversion to molecular ions adjacent to the plate when the electron temperature at the plate is of the order 2 eV. Volume recombination plays a negligible role on the onset of detachment, and is significant for temperature below 1 eV only. On the other hand, the simulations show a significantly less pronounced detachment onset, and weaker reduction of the ion currents to the target plates for electron temperatures below 1.5 eV, implying that the pressure losses should even be stronger than presently predicted.

The contribution describes the status of analyses of hydrogenic (hydrogen and deuterium) atomic line and molecular Fulcher-alpha band emission to characterize the atomic and molecular influxes for assessing the impact of ion-molecular interaction in edge fluid code predictions. These studies include the hydrogen isotopes hydrogen and deuterium, and future studies in tritium and deuterium-tritium plasmas will be discussed in the context of atomic and molecular fundamental data needed for including these isotopomers.

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