Use of new He II atomic data in JET EDGE2D-EIRENE simulations

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Present day large plasma machines use a divertor containing a cold, dense plasma to act as a buffer between the hot core and the plasma facing material surfaces, providing protection for these surfaces. The accurate prediction of the behaviour of the divertor plasma, including the power radiated by fuel and impurity species, is therefore crucial and requires transport modelling of the plasma edge and divertor. Such transport codes rely on the availability of accurate atomic and molecular data both for the fuel and impurity species. Recent work has resulted in a new atomic dataset for hydrogenic He II (He⁺) [1,2] and this is being tested in EDGE2D-EIRENE simulations. Helium is widely used in laboratory fusion experiments both as a fuel as in the first, non-nuclear phase of ITER, as a minority gas for RF heating and will occur as ash from the thermonuclear reactions. The use of He also has the advantage of testing the connection of the atomic physics data with the transport codes without the confusion that can result from the emission from molecules which cannot be avoided in D fuelled simulations. This is particularly pertinent since extra terms relating to the potential energy are sometimes included when the transport model accesses the atomic data, these in addition to the required kinetic energy contributions. This is the case when the EDGE2D transport code accesses atomic data contained in the ADAS database and it is necessary to understand whether the differences due to these potential energy terms are significant. Although agreement between ADAS and the new data has been found for the modelled power radiated by He II, there are significant differences for other terms affecting the electron power loss used in the simulations, particularly at low temperatures. Lawson et al. [3] demonstrated that the simulated temperatures were particularly sensitive to this term and this may limit the lowest temperatures that can be achieved in the simulations. Since the radiated power increases with decreasing temperature, any restriction of the temperature could explain the previously observed discrepancy in the measured and simulated radiated powers [4,5]. EDGE2D-EIRENE simulations for discharges with a high concentration (~80-90%) of He are being run to compare the effect of using ADAS data and the new He II atomic database.


*See the author list of E. Joffrin et al., to be published in Nucl. Fusion Special Issue, overview and summary reports from the 27th Fusion Energy Conference (Ahmedabad, India, Oct. 2018)