Comparisons of new He II atomic data with JET line ratio measurements and their application to EDGE2D-EIRENE simulations

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Helium is widely used in laboratory fusion experiments both as a fuel, for example in the first phase of ITER, as a minority gas for some RF heating schemes and will occur as ash from the thermonuclear reactions. In order to make reliable predictions for future devices and analyse discharges produced in ITER's non-nuclear phase, particularly the modelling of edge and divertor plasmas, it is essential that its atomic physics is documented and confirmed by comparison with experiment. To this end, hydrogenic He II (He^+) line intensity ratios measured during JET He density limit pulses with both single line-of-sight and scanning spectrometers are being compared with a newly created He II atomic physics database, which enables theoretical line intensity ratios to be determined through modelling of the populations of energy levels fed by all significant collisional and radiative channels [1,2]. A model in which a flow of fully stripped He ions populating the continuum is being tested to explain the VUV Lyman series line intensity ratios.

He II atomic data is connected to the EDGE2D transport code through the ADAS database. Although agreement between ADAS and the new data has been found for the modelled power radiated by He II, significant differences are found when describing the electron power loss or gain used in the simulations. At the lowest temperatures (<1 eV) a gain in the electron power is expected, largely due to the mismatch in collisional excitation (a power loss, but vanishingly small) and de-excitation (a larger power gain) of the n = 1-2 transition, where n is the principal quantum number. The difference in the power gain between the two databases can be more than on order of magnitude, the ADAS data effectively preventing the simulations from reaching the lowest temperatures. The radiated power increases with decreasing temperature and so the question arises as to whether this could explain the previously observed discrepancy in the measured and simulated radiated powers [3,4]. Lawson *et al.* [5] demonstrated that the simulated temperatures were particularly sensitive to this term. EDGE2D-EIRENE simulations are being run to compare the effect of using the different atomic databases.

[1] Lawson *et al*., 2019, J. Phys. B, **52**, 045001

[2] Lawson *et al*., 2019, To be submitted to J.Phys. B

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

[4] Canik *et al*., 2017, Phys. of Plas., **24**, 056116

[5] Lawson *et al.,* 2018, Proc. 45th EPS Conf., Prague

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