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R-matrix electron-impact excitation/ionization calculations for near-neutral ion stages of Tungsten

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Tungsten remains the element of choice for plasma facing components (PFCs) in the divertor region of ITER [1] and other past and present tokamak experiments [2, 3]. The impurity influx of tungsten from PFCs into the plasma while undesirable, as highlighted by Pütterich et al. [4], needs to be accurately quantified if we are to model tungsten erosion and redeposition. Previous work of Isler [5] and Murakami et al. [6] state that the presence of as little as 0.1% of this high-Z element, within the plasma may be sufficient to quench the reaction, confirmed by Pütterich et al. [4] but at even smaller quantities.

One accepted method to provide a prediction of the expected impurity influx of Tungsten from the divertor region of a tokamak is the SXB ratio [7]. The SXB ratio for a given line has the effective ionisation rate in the numerator; with the denominator representing the population of the upper level times the Einstein A-coefficient for a given transition.

The Dirac Atomic R-matrix Codes (DARC) have been quite successful in providing sufficiently accurate atomic structure and electron-impact collision strengths that underpin the determination of the upper level population [8,9,10]. The effective ionisation rates have a higher degree of uncertainty attached to them. Perturbative methods such as the distorted wave method have been employed but have shown to overestimate ground and meta-stable ionisation cross sections for near-neutral lighter systems. New RMPS ionisation cross sections shall be shown for W^{2+} and compared with available experimental data. Future work will consider the electron-impact excitation and ionisation of W and W^{+}.

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