P114

Electron-impact excitation of Ar II for application in magnetically confined fusion plasmas

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Detailed, accurate, complete atomic datasets, including energy levels, radiative transition probabilities, excitation and ionisation cross sections and recombination rates, are vital for accurately modelling fusion plasmas. The R-Matrix approach is well known to be one of the most powerful and reliable methods for calculating these atomic parameters.

Recent and ongoing developments of the relativistic parallel DARC codes have enabled an order of magnitude advance in the accuracy of the atomic structure and subsequent collision calculations that are now feasible for lowly ionised high Z ions, such as W I, W II and W III; additionally, this method remains viable for low Z ions, opening those ionisation stages to possible relativistic and semi-relativistic treatments.

Characterising the impurity influx, erosion and deposition of W ions in tokamaks is important for their future development. However, on occasion, it may be necessary to inject specific impurity ions into the plasma deliberately. For example, redistribution of the power radiated from the core to the reactor wall may be required to reduce any damage that may be caused to the plasma-facing wall components due to a high heat load and prolong tokamak lifespan. Impurities such as argon, nitrogen or neon improve plasma control and limit plasma disruptions that impede magnetic confinement. Unfortunately, there is currently a paucity of fine structure resolved atomic data in the literature for the first three ionisation stages of Argon, a key priority for the fusion plasma community.

To address these issues, the QUB group are undertaking a series of calculations for the electron-impact excitation of Ar II, results from which will be presented at the conference.

The fully relativistic DARC codes have been used to compute excitation rates for two models incorporating 15 and 31 configurations in the expansion of the target wavefunctions. These data will be compared and contrasted to a full Breit-Pauli pseudo-state calculation comprising all levels up to $n = 12$. The data presented will significantly impact the modelling and characterisation of magnetically confined fusion tokamaks and numerous astrophysics applications.

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