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Numerical calculation of charge exchange cross sections for plasma diagnostics[1]

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The diagnostics of impurity density and temperature in the plasma core in tokamak plasmas is carried out by applying the charge exchange recombination spectroscopy (CXRS) technique [R. C. Isler, Plasma Phys. Control. Fusion 36, 171 (1994)], where a fast beam of H atoms collides with the plasma particles leading to electron capture reactions with the impurity ions. The diagnostics is based on the emission of the excited ions formed in the electron capture. The application of the CXRS requires the knowledge of accurate state-selective cross sections, which in general are not accessible experimentally, and the calculation of cross sections for the high n capture levels, required for the diagnostics in the intermediate energy domain of the probe beam, is particularly difficult. In this work, we present a lattice numerical method to solve the time dependent Schrödinger equation. The method is based on the GridTDSE package [J. Suarez et al., Comput. Phys. Commun. 180, 2025 (2009)], it is applicable in the wide energy range 1 - 500 keV/u and can be used to assess the accuracy of previous calculations. The application of the method will be illustrated with calculations for collisions of multiply charged ions with H.

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