Charge Transfer Cross Section Calculations and Evaluations

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Abstract. Charge transfer processes in collisions of multi-charged ions with atoms have been subject to extensive theoretical and experimental studies during the last five decades. The important role of these processes in many laboratory and astrophysical plasmas stems from their large cross sections (proportional to the ionic charge) and pronounced final-state-selectivity. With increasing the ionic charge the higher and higher excited states are populated in the electron transfer process the radiation from which can serve as a useful plasma diagnostic tool, such as the widely used charge-exchange-recombination spectroscopy diagnostics in magnetic fusion plasmas. The electron capture processes of multiply charged impurity ions with the neutral hydrogen species are also important in the studies of impurity transport in the edge and divertor plasma regions. By using the full quantal molecular orbital close-coupling, the two-center atomic-orbital close-coupling and the solving time-dependent Schrodinger equation methods, we have calculated the charge transfer processes for numbers of systems, including proton with alkali atoms, Be^{q+}, B^{q+} and $C^{q+}$with H, N^{q+} with He, O^{q+} with H, He and H_2, and obtained the radiative and non-radiative total and state-selective charge transfer cross sections for the single- and double-electron capture processes. As an example, we also evaluated the total and state-selective cross section data in the collisions of Be^{q+} (q = 1-4) with H in a wide collision energy range, and the validity of different methods and the recommended data are presented.