State selective charge-transfer collisions of slow C^{6+} -H_2: A molecular-state Close-coupling study[#]

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Synopsis The molecular orbital close-coupling approach, based on the expansion of the molecular-states and augmented with the plane-wave translation factor, is applied to evaluate state-selective charge transfer cross sections of C^{6+} -H_2 at low energies.

Charge transfer becomes an important mechanism in establishing the ionization structure of a plasma containing multiply charged ionic systems present in many astronomical objects [1]. These processes may be highly state selective leading to product ions in excited states and the resulting emissions become a very useful diagnostic probe of plasma environment. Collisions of multiply charged ions with molecules are very common in astrophysical plasmas. As compared to the ion-atom collision, the ion-molecule calculations are rather more complicated. Among the molecules, H_2 is the simplest of all; the charge exchange with H_2 provides a recombination mechanism for multiply charged ions in X-ray ionized astronomical environments. Detailed information on the collision cross sections is essential to understand such behavior. The charge transfer of C^{6+} with molecular hydrogen at low energies is studied using a semi classical, impact-parameter, close-coupling approach based on the molecular-state expansion augmented with the plane-wave translation factor. Freezing the molecular feature of the target, the colliding system is approximated by a pseudo-one-electron system. During the course of the collision a transient quasimolecule comprising the entrance and various exit channels of the charge-transfer reaction is considered. Pseudo potential technique is applied to account for the binding of the electron in the transient diatomic quasimolecule. Both the partial and total cross sections show very good agreement with other theoretical and experimental results. The emission characteristics of the spectrum resulting from charge transfer are also presented.

[1] Bidhan C. Saha, "Collisions of fully and partially stripped ions with H_2 al low energies", in *Atomic Structure and Collision processes* (edt. Man Mohan) Narosa Pub. House (2011).

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