§13. Electron-loss Cross Section of H^- in Collision with Neutral Atoms

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With the necessity of plasma heating by intense neutral beam flux, the conversion of negative ions to neutral ones becomes promising in injecting the nuetral beam flux into a plasma. In this stage, the electron loss mechanism from the negative ions colliding with neutral target atoms plays an important role. From this point of view, we calculated the electron loss cross section of a H^- ion in a first-order perturbation.

In the present treatment, Born approximation was used and the diagonalization of the initial and final wave functions is introduced. The reaction processes are

$$H^- + A \rightarrow H^0(1s, 2s, 2p) + A + e^-$$

The initial state of two electrons in the H^- ion is assumed to be the 1s1s' state of Schull and Lowdin[1]. The ionized electron is described by a plane wave. The final state of a resulting hydrogen atom is chosed to be 1s, 2s, and 2p state. The target atom A is consider to remian in the ground state during the collision.

The calculated result for the loss cross section is shown in fig.1 together with the experimental data. The incident energy ranges from 2 keV to 10 MeV, and the target atom is helium. The dotted line, the dash-dot line, and the solids line are respectively obtained for a resulting hydrogen atom in the 2p, in the 2s, and in the 1s state. As one can see, the loss cross section for the 1s state H^0 creation is most dominant and the contributions of other processes are smaller by about one order.

We note that the present method improves the loss cross sections at low incident energies which had been obtained by the previous method. The calculated values are rather consistent with the data though a bit smaller as a whole. This method is going to be tested for other ion-target combinations.

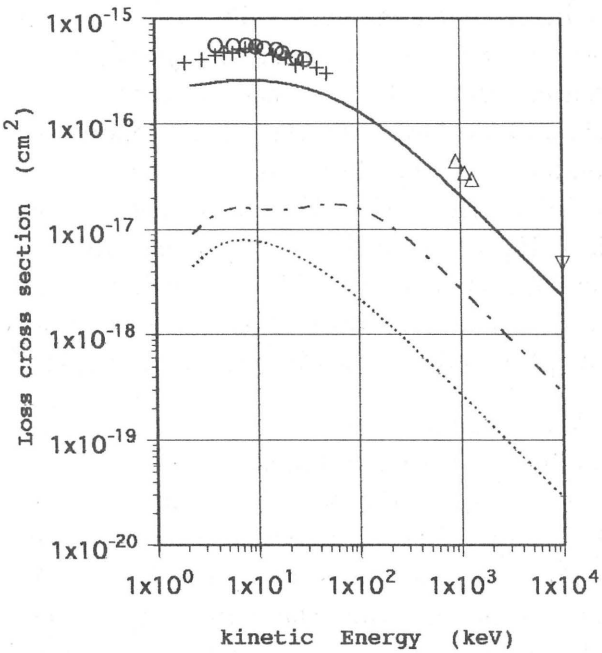

Fig.1. The calculated electron loss cross section of H^- colliding with heium atom with data[2].

References

1) H. Shull and P.O. Lowdin, J.Chem.Phys. 25, 1035 (1956).

2) J.F. Williams, Phys.Rev. 154, 9 (1967); G.I. Dimov and V.G. Dudnikov, Sov. Phys. -Tech.Phys. 11, 919 (1967) ; P.M. Stier and C.F. Barnett, Phys.Rev. 103, 896 (1956) ; K.H. Berkner et al., Phys.Rev. 134, A1461 (1964).