§16. Charge Dependence of Multi-electron Transfer Processes in Highly Charged Ion-Atom Collisions

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The charge exchange collision of highly charged ions (HCI) with atoms are very important atomic processes for understanding the edge plasma behavior in thermonuclear plasmas.

We have measured the charge dependence of branching ratios for the decay of multiply excited Rydberg ions which have been produced in 1.5q keV I^{q+} (q=10,15,20)-Ne,Ar,Kr and Xe collisions. Generally the multi- Rydberg ions produced in slow HCI-atom collisions are stabilized through radiative or Auger decay.

$$A^{q+}+B \longrightarrow A^{(q-j)+**}+B^{j+}$$
$$\longrightarrow A^{(q-i)+}+B^{j+}+(j-i)e^{-}+n(h\nu).$$

The branching ratios of this processes have been determined by coincidence techniques between final charge state distributions of projectile and target ions. We have also determined the absolute partial cross sections from one-electron capture cross sections measured by the initial growth rate method. Then we have obtained the i-electron capture cross sections after j-electron transfer ($\sigma^{j}_{q,\,q-i}$). It is found that Auger stabilization is dominant in all the decays studied. In addition, the number of Auger electrons increases with the increase of q and with the decrease of the ionization potential of target. For example, Figure 1 shows the branching ratios ($\sigma^{6}_{q,\,q-i}/\sigma_{total}$) i=1,2,3. It is noticed that the higher the charge number q of incident ions, the more electrons are emitted through autoionization of the multiply excited ions produced. There are consistent with the assertion that the correlation among excited electrons give important effects on Auger decay processes. The partial cross sections are compared with available experimental data and some scaling laws. The scaling law proposed by the present authors recently [1], which is based on the extended classical over barrier model, reproduces well the data within errors of 20%, suggesting that electron transfer cross sections are little affected by dynamical effects during HCI collisions.

On the other hand, the direct single ionization cross section ($\sigma^{1}_{q,\,q}$)for I^{20+}+Xe were also measured. This cross section is compared with other experimental data 2). We have been giving careful consideration to this process at present.

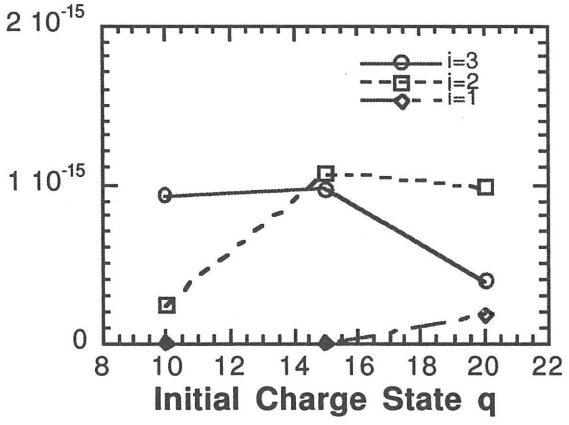

Fig.1. Branching ratios ($\sigma^{6}_{q,\,q-i}/\sigma_{total}$) for i=1,2,3 at I^{q+}+Xe.

References
1). Kimura,M. et.al., J.Phys.B28 L643(1995)
2). Cederquist,H.et.al.,Phys.Rev.A47,4551 (1993)