Multiple ionization of Ar dimers by slow highly charged ions: projectile dependence of screening effect

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Much attention has been called to the Coulomb explosion of molecules in collisions with slow (velocities of $v \ll 1$ au) highly charged ions. Recent progress of multiple coincidence techniques permits us to measure the dissociating ion pair distribution produced in the collisions. Such findings are of great interest from the viewpoint of multi-center multi-electron dynamics. In contrast with covalent molecules, however, little effort has been devoted to rare gas dimers.

About ten years ago, we proposed a three-center Coulombic over-barrier model to describe sequential multiple ionization of rare gas dimers [1]. In the preceding work [2], stimulated by an experiment [3] performed at GANIL in Caen, we modified the model so as to incorporate a partial screening effect in the non-active site ionized during a collision. It is found that the fragment ion pair (Q, Q') distribution is remarkably sensitive to the screening effect, which enhances the population of highly charge asymmetric pairs such as $(2, 0)$ and $(3, 1)$. It was found that recent measurement of the ion pair distribution in $A^{9+} + Ar_2$ collisions was best reproduced with the present model by taking a screening parameter of $s = 0.4$.

In the present work, we investigate how the screening effect manifests itself in the ion pair distribution, and how it depends on the projectile charge. As shown in figure 1, the proportion of asymmetric ion pair $(2, 0)$ increases with the screening parameter s. On the other hand, the $(2, 0)$ population vanishes in $A^{20+} + Ar_2$ collisions if one keeps the parameter value $s = 0.4$. We desire the experiment to be compared with present result.

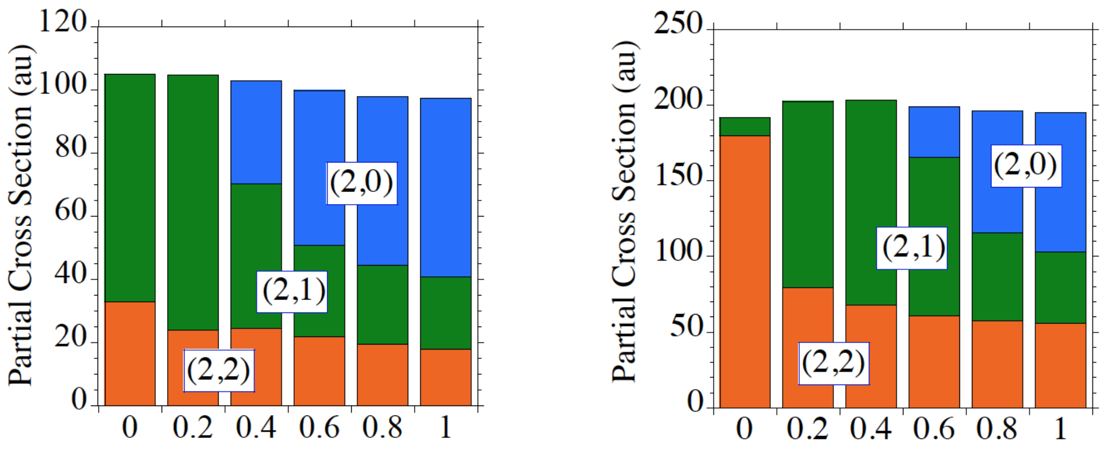

Figure 1: Dependence of ion pair (Q, Q') formation cross section on the screening parameter s for $A^{9+} + Ar_2$ (left side) and $A^{20+} + Ar_2$ (right side).

References:
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[3] J. Matsumoto, *et al.*, Phys. Rev. Lett. **105**, 263202 (2010).