The studies of charge transfer in the interaction between highly charged ions and molecule at Fudan University

Long Wei[1, 2], Jie Han[1, 2], Bo Wang[1, 2], Baihui Ren[1, 2], Yaming Zou[1, 2], and **Baoren Wei[1, 2*]**

[1] Institute of Modern Physics, Fudan University, Shanghai, China

[2]Key Laboratory of Nuclear Physics and Ion-Beam Application (MOE), Fudan University, Shanghai, China

*e-mail: brwei@fudan.edu.cn

Cross section, being amongst the most important parameter in describing atomic collision processes, can point towards the relevant reaction mechanisms and also have been used as key physical quantities for checking many-body theories [1]. On the other hand, cross sections for the interaction between ions and atoms play an important role in understanding astrophysical plasmas and fusion plasma diagnostics. However, due to the complicated collisional processes and high costs involved in experimental measurements, cross sections for highly charge ions interacting with atoms/molecules are still limited. We start to systematic study of the interactions between ions and atoms/molecules based on the highly charged ion collision platforms Shanghai [2]. Using a reaction microscope, the three dimension momenta of the projectile ions, the recoil ions and the free electrons can be measured in multi-coincidence for the interaction of ions with atoms/molecules. Then both the transfer ionization cross sections and state-selective differential cross sections can be deduced, and the fragmentation mechanism of molecular ions also can be analyzed with the three dimensional momentum measurement.

At the same time, Base on time-dependent density functional theory non-adiabatically coupling with molecular dynamics, we investigated the ion-atom/molecule collision processes. Aiming at many-electron systems with large spacial scale, we proposed an approximate method to extract the electron capture cross sections, avoiding explicit dependence on the final scattering wave functions. To demonstrate the reliability of the method, we reconstructed the electron capture and ionization cross sections in N_2 system in collision with proton [3]. The results agree reasonably well with the experimental data and semi-empirical results in the keV energies.

In this report, I will first introduce the experimental facilities for highly charged ion colliding with atoms and molecules, then present some new result.

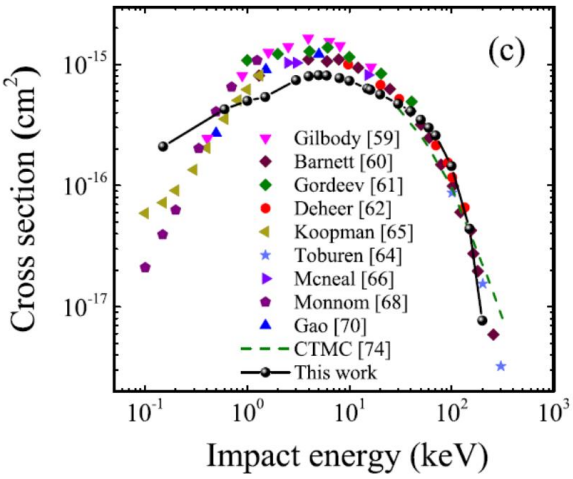

Figure 1 Total electron capture cross sections comparison to experimental data as a function of impact energies, more detail could be find in ref. [3].

References

[1] J.W. Gao, Y. Wu, J. G. Wang, et al, Phys. Rev. Lett. **122**, 093402 (2019);

[2] Y. Zhang, B. Wang, L. Wei, et al, J. Chem. Phys. **150** 204303 (2019);

[3] W. Yu, C.-Z. Gao, Y. Zhang, *et al*, Phys. Rev. A **97**, 032706 (2018).