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Multiple Ionization of Ne in coincidence with partially stripped B^{2+} ions in the intermediate energy regime

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Synopsis: A projectile ion-recoil ion and electron-recoil ion coincidence technique has been used to study the multiple ionization process in collisions of 0.75-4.0MeV B^{2+} with Ne atoms. Absolute total and partial pure ionization cross sections are reported for the first time at these impact energies with the present setup. The relative contribution of each recoil charge state has been investigated. The experimental data are compared to CDW-EIS calculation and with He^{2+} projectiles. The data throw further light on the effect of projectile screening in the ionization of multi-electronic targets and provide a support for the validity of the CDW-EIS model in this intermediate–to low velocity regime.

The projectile ion-recoil ion and electron-recoil ion coincidence technique has been used to investigate the target´s charge state distribution and their partial ionization cross sections for different collision channels in the intermediate-to-low energy regime. In this work we describe our new experimental setup to carry out ion-atom and ion-molecule collisions studies, focusing on the pure ionization channel and reporting the Ne^{q+} recoil ions production in the collision of 0.75-4.0 MeV partially stripped B^{2+} projectiles.

In the intermediate-to-low velocity regime electron capture is coupled with ionization, and small impact parameters play an important role to the ionization cross section. Within this scenario, the effective charge of the projectile during the ionization process can be larger than the projectile charge. How much large it is, is an important question, which depends both on the collision dynamics and on the electronic configuration of the projectile.

As the 2s radius of B^{2+} is large compared to the Ne atomic radius, the partial screening of the projectile vary significantly along the ionization trajectory. The experimental results are compared with Continuum Distorted Wave-Eikonal Initial State (CDW-EIS) including post-collisional interaction [1] and dynamic screening of the projectile.

For the determination of the total and partial pure ionization cross sections the absolute total electron capture cross sections and the partial yields of the total and pure ionization process were measured. Figure 1 displays the comparison between the measured absolute partial pure ionization cross section and the CDW-EIS calculations for B^{2+}, as well as the same kind of measurements with He^{2+} as projectile. It is clear from the figure that B^{2+} is much more effective that He^{2+} in producing highly charged Ne recoil ions. The projectile nuclear screening due the 2s electron of B^{2+} becomes less effective for close collisions and the effective nuclear charge becomes larger than two.

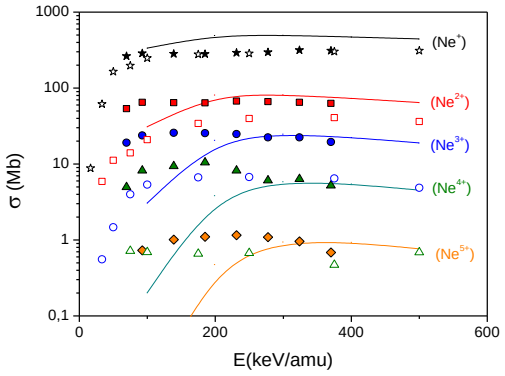

Figure 1: Absolute partial pure ionization cross sections: Experimental data for B^{2+} projectiles (this work), full symbols, and for He^{2+} projectiles (Ref. 2) open symbols and CDW-EIS calculations, full lines.

References

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