State-selective single electron capture in slow He^+-He collisions

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Synopsis The state-selective and angular differential cross sections for single electron capture in slow He^+-He collisions are studied at impact energies between 0.25 keV/u and 5 keV/u. The cold target recoil ion momentum spectroscopy was used to measure the momentum vector of recoil He^+ ion in coincidence with scattered projectile He^0. The single electron capture into the ground state of projectile is dominant in the whole research energy range. The oscillatory structures of angular differential cross sections for ground state electron capture are well reproduced by our theoretical calculation based on the two-center atomic orbital close-coupling method.

Single-electron capture processes in He^+-He collisions have been widely studied in past decades. Most of these focused on the total single electron capture cross section [1]. However, only a few works focused on the studies of the differential cross section [2, 3, 4]. The collision energies are 0.0625 keV/u to 1.25 keV/u [2], 7.5, 25 keV/u [3], and 60, 150, 300, 630 keV/u [4].

In the present work, we performed the experiments at a recently built EBIS platform [5] combined cold target recoil ion momentum spectroscopy (COLTRIMS/reaction microscopes) [6] at the Institute of Modern Physics in Lanzhou. The fully differential cross sections of single electron capture have been obtained in He^+-He collisions at impact energy between 0.25 keV/u and 5 keV/u.

The experimental results indicate the single electron capture into the ground state (n=1) of the projectile is dominant. The relative contribution of single electron capture into excited states (n=2) of the projectile increases with the increase of projectile energy. The angular differential cross sections of the ground state capture show obviously oscillating structure. Our results agree well with the experiment of Gao et al at 1.25 keV/u [2]. In order to understand the oscillatory structure of differential cross sections, we also performed the theoretical calculation using the two-center atomic orbital close-coupling method (TC-AOCC) [1]. The theoretical calculation reproduced the oscillatory structure of differential cross sections which strongly correlated to the oscillatory structure of impact parameter dependence of electron probability. Figure 1 shows the angular differential cross sections of single electron capture into the ground state of the projectile at an impact energy of 3.75 keV/u.

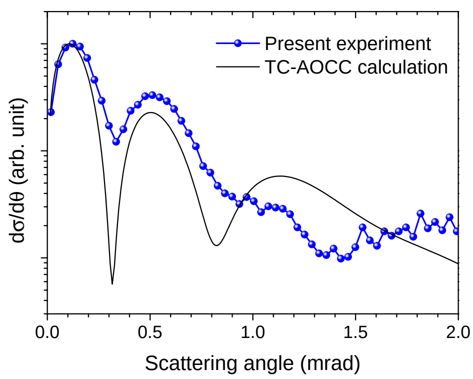

Figure 1. Angular differential cross sections for single electron captured into n=1 state of projectile He^+ at an impact energy of 3.75 keV/u. The data normalized to the maximum of the differential cross section.

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References

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