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Electron transfer and ionization in collisions of He-like ions with Na(3s) and Na(3p)

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Synopsis Single electron transfer and ionization in collisions of He-like ions (N^{5+}, O^{6+}, Ne^{8+}) and Na has been investigated both experimentally and theoretically at energies around the matching velocity of the valence electron (2 to 10 keV/amu). State selective cross sections and scattering angle distributions were obtained using recoil-ion momentum spectroscopy in combination with a magneto-optically cooled Na atom target. A strong dependence of the relative cross sections on the collision energy is observed. The results are compared with Classical-Trajectory Monte Carlo (CTMC) calculations and show an overall very good agreement.

Single electron transfer and ionization in collisions of multiply charged ions with alkali atoms such as Na are an example of dynamics of a few-body Coulomb system. Alkali atom targets are also easily prepared in either ground or excited states which influences the electron capture and ionization processes since they are very sensitive to the initial binding energies of the active electrons. As an applied aspect it should be noted that Na can be used to mimic metastable helium, which is a species of relevance to fusion plasma research.

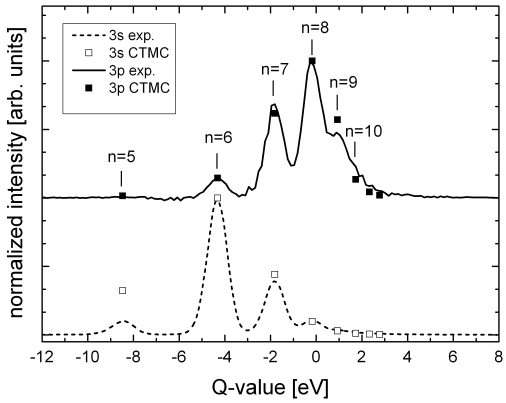

Figure 1. Experimental and theoretical energy gain (Q-value) spectra of Na^+ recoils from 2.5 keV/amu N^{5+}+Na(3s) and N^{5+}+Na(3p) collisions.

In comparison with a ground state target collisions with excited Na show a clear shift in the main capture channels and an increase in the ionization cross section. The relative cross sections also display a strong dependence on the collision energy with an increasing preference for highly excited final states for increasing collision energy.

The present experimental results are contrasted to n-state selective cross sections obtained by the CTMC model described in [1].

The recoil momentum spectra also provide the scattering angle distributions of the projectile. A comparison of the exprimental and theoretical distributions is shown in figure 2.

Overall, the experimental results and theoretical calculations are in very good agreement.

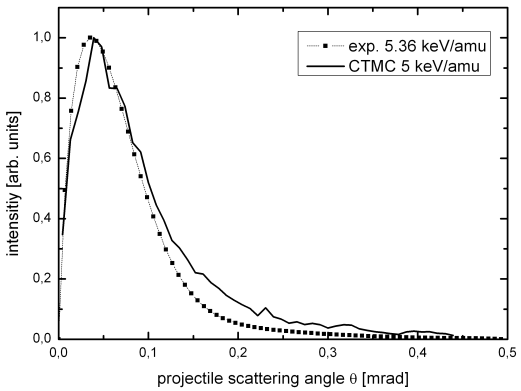

Figure 2. Experimental and theoretical projectile scattering angle distribution for N^{5+}+Na(3s) → $N^{4+}(6\ell)$+Na^+ reaction channel

References

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