Cross sections for single electron capture, transfer ionization and direct ioniza-tion in Li^{3+}- Ne collisions

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Cross sections for single electron capture, transfer ionization and direct ionization in Li^{3+}- Ne collisions.

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Synopsis: Multiple ionization cross sections of Ne atoms are reported for Li^{3+} impact in the energy range of 2 to 5.8MeV. The neon ionization cross sections were separated into three collision channels, namely; direct ionization (DI), single capture (SC) and transfer ionization (TI). The direct ionization data is compared to CDW-EIS calculations as well as to other projectiles with charge state q = 3+. The single capture is compared to a modified Bohr-Lindhard semi classical model.

We have measured Ne^{q+} ionization cross sections in the collision with Li^{3+} projectiles with energies ranging from 100 to 1000 keV/amu., using a coincidence time–of-flight technique.

In this intermediate-to-high velocity regime ionization and electron capture competes and, to study the role of projectile screening in collisions involving dressed projectile ions, the study of bare projectiles is a key reference for comparison.

Several collision channels were studied in the present work, namely single electron capture (SC), transfer ionization (TI) and direct ionization (DI). This set of measurements, carried out using two collision chambers - with a gas cell and a gas jet - at the same beam line of the Pelletron accelerator at the Federal University of Rio de Janeiro, allowed us to obtain independent, absolute cross sections for multiple ionization of Ne for these collision channels. Our Li^{3+} data were compared to other q=3+ projectiles data, C^{3+} [1], Ne^{3+} [2] and F^{3+} [3].

The measured ionization data is compared to the Continuum Distorted Wave-Eikonal Initial State (CDW-EIS), including post-collisional interaction [4] and to the Semi-classical Approximation, evaluated for C^{3+} [1]. For single electron capture, calculations based on the Bohr-Lindhard model are also presented [5].

Our results for multiple ionization of Ne associated with electron capture are shown in Figure 1. Total electron capture and TI cross sections are shown for Li^{3+} and C^{3+} [1]. A clear crossing between the production of Ne^{+} and Ne^{2+} cross sections occurs at ~ 200keV/amu indicating the predominance of TI over SC for high projectile velocities. This predominance occurs for the whole set of the present L^{3+} data and is due to the increasing role played by close collisions as the projectile velocity increases. The observed TI/SC ratio is nearly constant for the whole measured velocity range, in a marked contrast with results for He target [6], which indicates that a post-collisional contribution must be added to the Independent Particle Model to properly describe the TI.

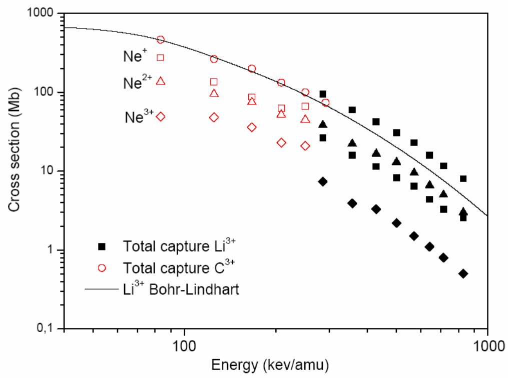

Figure 1: Measured total electron capture and TI cross sections for Li^{3+} (this work; full symbols) and C^{3+} (Ref.1, open symbols) on Ne. Full line: Borh-Lindhard model [5] for total electron capture .

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