



DEPARTMENT OF PHYSICS INDIAN INSTITUTE OF TECHNOLOGY KANPUR

PHYSICS COLLOQUIUM ON “AUGER-MEITNER ELECTRON SPECTROSCOPY: A TECHNIQUE TO STUDY CHARGE EXCHANGE PROCESSES IN ION-ATOM COLLISION ”

Abstract

In energetic ion-atom collisions with low Z projectile-target pair, inner-shell ionization is predominantly accompanied by relaxation via the Auger-Meitner electron emission channels. The inner-shell vacancy creation occurs in close impact parameter collisions and in case of highly energetic and/or multiply charged projectile ions, it is often accompanied by multiple ionization of the outer shells. Multiple vacancy production modifies the electronic configuration of the collision partners.

In our recent work, we have investigated L-MM Auger-Meitner electron emission following collisions of 600 keV Ar ions with atomic Ar. In this combined experimental and theoretical study, we have measured energy and angle resolved electron emission to reveal distinct contributions from target and projectile Auger-Meitner decay. The measured projectile ion peak energies are in excellent agreement with kinematic calculations considering the Doppler shift in energy in the laboratory frame. We have also measured the angular SDCS which are well reproduced by an isotropic emission model in the target and projectile rest frame. A theoretical model using the ground state Hartree-Fock SCF wave functions has been developed to calculate the transition probability for L-shell Auger-Meitner transition in atomic Ar and multiply charged Ar ions. Comparison of the experimentally measured DDCS spectra with the simulated Auger-Meitner spectra for prominent L-MM transitions, reveal that the measured electron emission peaks correspond to multiply ionized Ar ion species rather than singly ionized Ar atoms. In addition, the nearly identical Auger-Meitner peak energies obtained for various Ar projectile ions signify the important role of multiple ionization, charge exchange, and subsequent charge-state equilibration processes, resulting in an equilibrium charge state of the target-projectile ion pair preceding the Auger-Meitner decay. Our results highlight the significant influence of collision-induced electronic rearrangement on Auger-Meitner decay and provide new insights into the role of multiple vacancy creation, charge equilibration, and quasi-molecular interactions in slow, highly charged ion-atom collisions.

SPEAKER



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