K-LL Auger - Meitner emission in symmetric projectile ion - target molecule collision

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Auger - Meitner (AM) electron spectroscopy is a powerful technique for studying inner-shell processes and electron - electron correlations in atomic and molecular systems. The K-LL emission provides detailed information about Auger transition probabilities, angular distributions, and post-collision interaction dynamics. In ion-atom/molecule collisions, Auger spectroscopy is especially useful for understanding target and projectile ionization mechanisms.

In this work, we report measurements of absolute double differential cross sections (DDCS) for AM electron emission from symmetric projectile - target collision system. The K-LL AM electron yields have been measured in 200 - 270 keV $C^{1,2+}$ and $N^{1,2,3+}$ collisions with CH_4 molecules. Angular distributions of Auger electrons were studied over emission angles from 30° to 150° and show nearly isotropic behavior [1]. The appearance of target and projectile AM peaks in the electron spectra were further investigated by calculating the AM transition rates. The calculations were performed using non-relativistic screened hydrogenic and Hartree - Fock wave functions. The Gordon wave function for the emitted electron shows better agreement with experimental results compared to the free-particle wave function. Measured Doppler shifts for both target and projectile emissions are in good agreement with calculated values.

As part of our current work, we are calculating Auger transition rates using newly generated wavefunctions obtained from the Kohn–Sham potential [2]. These wavefunctions are expected to provide improved descriptions of the excited-state energy levels. In parallel, we are planning to investigate Auger–Meitner (AM) processes using a higher-charge-state projectile ion, such as C^{3+} to investigate whether electron capture by the projectile is followed by Auger–Meitner decay of the excited projectile state.

In the near future, we plan to extend this work through theoretical calculations and experimental studies using a charge state analyzer (CSA), focusing on post-collision processes such as electron capture cross sections of charged projectile ions and Auger electron emission from charged projectiles.

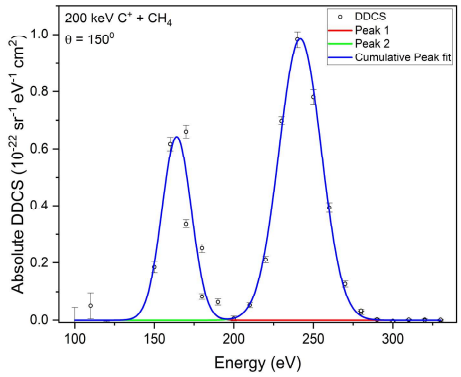

Figure 1. Target and projectile K-LL AM peaks in 200 keV C^{1+} collision with CH_4.

References

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