

Investigation of the C^{3+} KLL spectrum obtained in collisions of 6-15 MeV C^{4+} ($1s^2, 1s2s\ ^3S$) with gas targets*

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We have initiated systematic studies on the single electron capture to the $1s2s\ ^3S$ long-lived component of a mixed-state ($1s^2, 1s2s\ ^3S$) He-like ion beam produced by the Tandem accelerator. A zero-degree Auger projectile spectroscopy (ZAPS) setup, recently implemented at the Demokritos 5.5 MV Tandem accelerator, is used for obtaining the necessary high resolution KLL Auger spectra [1]. The $1s2s2p\ ^{2,4}P$ states, observed in the ZAPS spectra, may result from direct $2p$ electron capture to the $1s2s\ ^3S$ initial state or higher lying ($1s2s\ ^3S$) nl states leading to the production of $1s2snl\ ^{2,4}L$ states which can then selectively feed the $1s2s2p\ ^4P$ state by E1 cascades [2, 3]. These $1s2s2p\ ^{2,4}P$ states should be produced in the ratio $R_m \equiv ^4P/^2P = 2$, as obtained by spin statistics in the absence of cascades.

The $1s^2$ ground state component of the beam also contributes to the production of the $1s2s2p\ ^2P$ states by transfer-excitation processes [2, 3, 4], thus also affecting the observed R_m ratio. To isolate the $1s2s\ ^3S$ capture contribution, a new technique is employed [4] requiring the measurement of two different electron spectra with beams having significantly different $1s2s\ ^3S$ content. Moreover, the $1s2s2p\ ^4P_J$ J-components are also metastable and therefore Auger decay all along the projectile path, after excitation in the gas cell. Depending on lifetime, this results in a substantial increase of the spectrometer acceptance solid angle requiring a crucial J -dependent correction to the measured metastable $^4P_{1/2, 3/2, 5/2}$ electron yield. This correction has also been applied to our ZAPS measurements utilizing a Monte Carlo electron trajectory simulation approach within the SIMION charged particle optics software [5] and was also experimentally verified [6]. Preliminary results on the R_m capture ratio will be presented and commented accordingly.

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References

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