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Use of Gas and Foil strippers for the production of He-like ionic beams in both pure ground state ($1s^2$) and mixed states ($1s^2$, 1s2s) for zero-degree Auger Projectile Electron Spectroscopy

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Synopsis We present the unique benefits of gas and foil pre- and post- stripping in the production of pure ground state ($1s^2$), as well as mixed ($1s^2$, 1s2s) state He-like beams. The availability of such beams in TANDEM accelerators is of vital importance in studies concerning the population mechanisms of the 1s2s2p ^{4}P metastable states produced in collisions of these He-like beams with gaseous targets.

The new research initiative APAPES funded by THALES* has so far established a new experimental station at the 5.5MV TANDEM of the NCSR "Demokritos" in Athens with a dedicated beamline for atomic collisions physics research [1].

The main apparatus, developed for zero-degree Auger projectile spectroscopy, has been put together to perform high resolution studies of electrons emitted at zero degrees with respect to the ionic beam in ion-atom collisions. This apparatus consists of a hemispherical deflector analyser equipped with a 4-element entry zoom lens and a 2-dimensional position sensitive detector in operation with a doubly-differentially pumped gas target. It is currently fully operational and used in performing systematic isoelectronic investigations of K-Auger spectra emitted from collisions of He-like ions with gas targets. Our goal is to provide a better understanding of the cascade feeding of the 1s2s2p ^{4}P metastable states produced in collisions of He-like and H-like ions with gaseous targets [2].

Our experimental results so far were limited to the case of capture measurements to a mixed state ($1s^2$, $1s2s\,^3S$) of 12 MeV C^{4+} ion beam generated at the TANDEM terminal foil stripper. In order to perform measurements with pure as well as mixed state beams, it is necessary to incorporate: i) A gas stripper hosted inside the TANDEM terminal that will allow us to obtain pure ground state ionic beams [3], ii) A stripping point along the beam line of the accelerator hosting both foil and gas post strippers. This will allow us to obtain mixed state beams at different fractions vital for our research goals. Both options are under construction and should soon be fully operational.

The expected charge state intensities resulting from the stripping are calculated from a charge state analysis code using mainly the semi-empirical formulas of Nikolaev Dimitriev [4] and Sayer [5] along with the energy of the beam, its characteristics (Z, atomic mass) and incoming charge state.

Measurements of zero-degree Auger spectra following single state electron transfer to mixed state C^{4+} ($1s^2$, $1s2s\,^3S$) in collisions with various gaseous targets along with a thorough description of both gas and carbon foil strippers will be presented.

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