Li-like carbon Auger KLL measurements of mixed-state $C^{4+}(1s^2\,{}^1S,\ 1s2s\,{}^3S)$ ions in 6-15 MeV collisions with He and comparison to 3eAOCC calculations†

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Synopsis New state-resolved Li-like carbon Auger KLL measurements of mixed-state $C^{4+}(1s^2\,{}^1S,\ 1s2s\,{}^3S)$ ions in 6-15 MeV collisions with He are presented. Results of three-electron semiclassical atomic orbital AOCC coupled channel (3eAOCC) calculations are also presented and compared.

State-resolved cross sections for the production of $1s2s^2\,{}^1S$, $1s2s2p\,{}^4P$, $1s2s2p\,{}^2P_{\pm}$, and $1s2p^2\,{}^2D$ were determined using our zero-degree Auger projectile spectroscopy (ZAPS) setup at the 5.5 MV tandem accelerator at Demokritos [1]. These states are populated predominantly by transfer-excitation processes from the $1s^2$ and/or by single electron transfer processes from the $1s2s\,{}^3S$ metastable components.

Using our recently reported dual measurement technique [2], we have separated ground state from metastable state KLL contributions in collisions of mixed-state $C^{4+}(1s^2\,{}^1S,\ 1s2s\,{}^3S)$ ions in 6-15 MeV collisions with He.

For the interpretation and understanding of the experimental results we also performed calculations over the 0.5-18 MeV range using a semiclassical atomic orbital close-coupling approach, based on an asymptotic (atomic) description of the neutral and charged collision partners [3,4]. The electronic dynamics is then treated quantum mechanically solving the three-electron time-dependent Schrödinger equation with full configuration interaction (CI).

To describe electron excitation and transfer to doubly excited states on the carbon center, three active electrons are taken into account: two of them are reserved for the He-like C^{4+} projectile, while the third is initially on the He target, accounted for by a He^+ model potential binding a unique electron which can be transfered in the collision to C^{4+} to describe 1-, 2- and 3-open-shell electronic configurations of the C^{3+} ions. An illustration of our results is shown in Fig. 1 for the production of the $C^{3+}(1s2p^2\,{}^2D)$ state. Results for the other KLL states will also be presented.

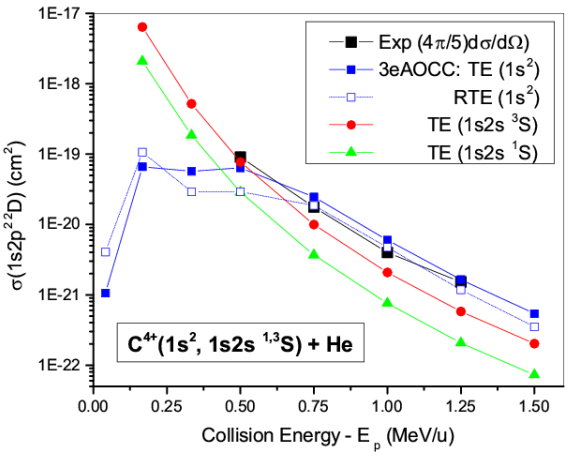

Figure 1. Cross sections for the production of the $C^{3+}(1s2p^2\,{}^2D)$ state in collisions of $C^{4+}(1s^2\,{}^1S,\ 1s2s\,{}^{1,3}S)$ ions with He. ZAPS measurements (black squares), 3eAOCC results: (squares) from $1s^2$, (circles) from $1s2s\,{}^3S$ and (triangles) from $1s2s\,{}^1S$ metastable states, respectively. RTE assessment (open squares) is also indicated in good overall agreement with experiment.

References

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