Production of hollow 2s2p ^{3,1}P states in collisions of C^{4+} ($1s^2$ ^{1}S, 1s2s ^{1,3}S) ions with gas targets*

A. Laoutaris[1, 2], I. Madesis[1, 2], S. Nanos[2, 3], E. P. Benis[3], A. Dubois[4] and T.J.M Zouros[1, 2]

[1] *Department of Physics, University of Crete, Voutes campus, GR 71003 Heraklion, Greece*
[2] *Tandem Accelerator Laboratory, INPP, NCSR Demokritos, GR 15310 Ag. Paraskevi, Greece*
[3] *Department of Physics, University of Ioannina, GR 45110 Ioannina, Greece*
[4] *Sorbonne Université, CNRS, Laboratoire de Chimie Physique Matiére et Rayonnement, Paris, France*
Presenting author email: laoutaris@physics.uoc.gr

The production of the doubly-excited 2s2p ^{3,1}P hollow states in collisions of fast (few MeV/u) He-like C^{4+} ($1s^2$, 1s2s) mixed-state ion beams with gas targets is reported. He-like beams are routinely delivered by tandem accelerators in a ($1s^2$ ^{1}S, 1s2s ^{1,3}S) mixed-state, the content of which depends on the type of ion-stripper (gas or foil), as well as the stripping energy [1]. Based on metastable fraction-controlled measurements of the Auger decay spectra of the 2s2p ^{3,1}P states [2] and a technique developed by our group that allows for determining the ion beam content [3,4], we have initiated a systematic isoelectronic investigation on the processes contributing to the production of the doubly excited 2s2p ^{3,1}P hollow states. These include the first order process of direct electron excitation, the second order processes of double electron excitation and the process of electron transfer-loss. So far, we have performed experiments for collision energies between 0.5 and 1.5 MeV/u C^{4+} with H_2, He, Ne and Ar gas targets. Our experimental results are accompanied, for the case of He gas targets, with state-of-the-art theoretical three-electron atomic orbital coupled channel calculations using the semi-classical close-coupling approach [5]. Calculations are seen to overall reproduce the experimental data after accounting for the ion beam metastable content, and thus, provide valuable quantitative information about the processes involved.

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