Investigation of *2s2p* $^{3,1}P$ excitation and *(1s2s* ^3S*)nl* capture lines in 6-18 MeV C^{4+} ($1s^2$, 1s2s ^{3}S) collisions with gas targets

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Synopsis: Using zero-degree Auger projectile electron spectroscopy we investigate the *(2s2p* $^{3,1}P$*)* KLL lines due to 1s-2p excitation and the *(1s2s* ^3S*)nl* KLn lines formed by nl capture in pre-excited He-like ions colliding with various gas targets.

A zero-degree Auger projectile spectroscopy apparatus composed of a single stage hemi-spherical deflector analyser with a four-element injection lens and a 2-dimensional position sensitive detector combined with a doubly differentially pumped gas target gas has been newly set up at the Demokritos 5.5MV tandem accelerator for high resolution studies of electrons emitted from ions colliding with gas targets. Using this setup we have started a systematic isoelectronic investigation of projectile K-Auger electrons emitted from pre-excited He-like ions in collisions with dilute gas targets [1]. The goal is to study single electron capture to the He-like *(1s2s*^{3}*S)* metastable beam component [2,3], explore the effect of varying the metastable fraction [4] and the dependence of the ratio R_m of $^4P^o/^2P$ Auger KLL line intensities due to capture to the *1s2s* ^3S of recent interest [5].

To obtain an independent cross check on the C^{4+}*(1s2s*^{3}*S)* metastable beam fraction, apart from the new method recently introduced [5] based on the analysis of the KLL lines in He-like beams with different metastable fraction, we have also explored the production of various Auger lines of slightly higher electron energy such as the He-like *2s2p* $^{3,1}P$ KLL produced by 1s-2p excitation shown in Fig. 1. These lines are also of particular importance in the detailed study of fundamental mechanisms of excitation [7], i.e. the electron-nucleus, electron-electron and electron-electron excitation with spin exchange [8].

The presently unidentified lines in Fig. 1 are most probably due to *(1s2s*^{3}*S)nl* Li-like states [6] produced by direct *nl* capture with n=3-4 to the metastable *1s2s* ^3S beam component. Their existence would be further proof that these higher lying states are produced by capture as required by the proposed cascade mechanisms [3,5] leading to the observed enhancement of the ratio R_m [2].

Latest results on these excitation and capture cross sections and their dependence on the collision energy will be presented.

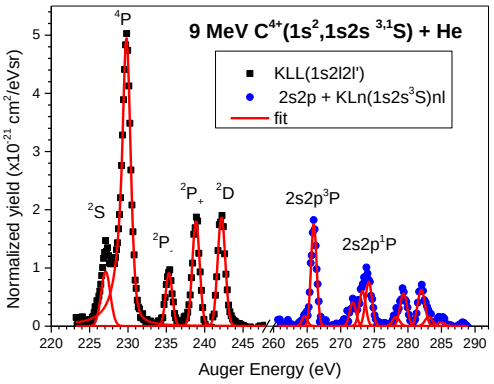

Figure 1. 9 MeV C^{4+}*(1s*^{2}*,1s2s* ^{3}*S)* collisions with He. Auger lines: (squares) C^{3+}*(1s2l2l′)* KLL, (circles) C^{4+}*(2s2p* ^{3,1}*P)* KLL and C^{3+}*(1s2s*^{3}*S)nl* KLn (n=3-4). The beam was produced by gas stripping in the accelerator terminal and subsequent gas post stripping of the analyzed C^{3+} ions.

References

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