

# ROLE OF SHAKE-UP TRANSITIONS ON THE AUGER CASCADES OF LIGHT AND MEDIUM ELEMENTS

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In recent years, coincidence spectroscopy of photo and Auger electrons helped to investigate many details in the de-excitation of atoms, molecules and solids. By measuring especially the kinetic energies of all (or at least most) of the emitted electrons, following the creation of an inner-shell core hole, information has been obtained about both, the pathway of Auger cascades as well as the final-state distributions. While the total kinetic energy of electrons often enables one to obtain information about the spectrum of the final states, measurements on the individual electrons reveal details about the intermediate states and decay pathways.

To analyze such Auger cascades in further detail, we have extended the RATIP program [1] to deal with the multiple emission of electrons and to explore the total ion yields in such cascade experiments, cf. Ref. [2]. In a number of case studies, we here found that most Auger cascades are strongly affected by shake-up (or down) transitions in which either the initial photo ionization and/or some of the Auger decays are accompanied by the (de-) excitation of a valence electron. These shake transition may lead to (multiply-charged) final states that are otherwise not accessible for energetic reasons. For the two-step cascade that arises in course of the photo ionization of a 4s or 4p electron of atomic cadmium, for example, figure 1 displays the simulated final-state spectrum for the ionization with 200 eV synchrotron radiation [3]. In the lower part of this figure, we here show the kinetic energies of the emitted electrons relative to the  $4d^{10}5s^2\ ^1S_0$  ground-state of atomic cadmium. Since the  $4d^95p$  configuration does not appear in any of the pathway, that emerges from just a 4s or 4p hole of singly-ionized cadmium, the population of this configuration must obviously occur due to shake-up transitions.

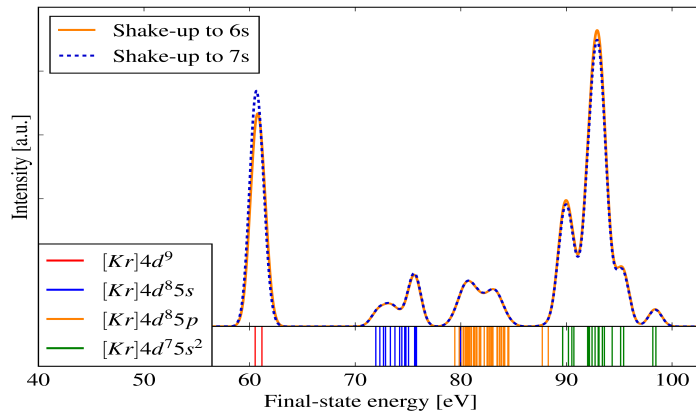


Figure 1: Calculated final-state spectrum of triply ionized cadmium. We consider two sequential Auger steps that follow the removal of an inner-shell 4s or 4p electron in atomic cadmium by a 200 eV photon.

In this talk, we shall discuss the role of shake-up transitions for the Auger cascades of different atoms and ions, from 1s core-excited O<sup>-</sup> ions up to 4s and 4p photo ionized cadmium.

## References

- [1] S. Fritzsche, Comp. Phys. Comm. 183, 1525 (2012).
- [2] P. Linusson *et al.*, Phys. Rev. A 83, 023424 (2011).
- [3] J. Andersson *et al.*, Phys. Rev. A 92, 023414 (2015).