Post-collision interaction in Potassium 3s photoionization

S Sheinerman, P Lablanquie, L Andric, K Ito, J Palaudoux, S-M Huttula, M Huttula, K Jänkälä, J Soronen, J-M Bizau, et al.

Post-collision interaction in Potassium 3s photoionization

2015 J. Phys.: Conf. Ser. 635 092086

(http://iopscience.iop.org/1742-6596/635/9/092086)

Journal of Physics: Conference Series **635** (2015) 092086 doi:10.1088/1742-6596/635/9/092086

Post-collision interaction in Potassium 3*s* photoionization

S. Sheinerman[1], P. Lablanquie[2], L. Andric[2], K. Ito[2], J. Palaudoux[2], S-M. Huttula[3], M. Huttula[3], K. Jänkälä[3], J. Soronen[3], J-M. Bizau[4], S. Guilbaud[4], D. Cubaynes[4], and F. Penent[2]

[1] Department of Physics, St.Petersburg State Maritime Technical University, 198262 St.Petersburg, Russia
[2] LCPMR, CNRS & Université Paris 06, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France
[3] Department of Physics, MOMA-RC, P.O. Box 3000, 90014 University of Oulu, Finland
[4] ISMO, CNRS UMR 8214, Université Paris-Sud, Bâtiment 350, F-91405 Orsay, France

Synopsis The post-collision interaction (PCI) distortion of the Auger electron line shapes after K 3s photoionization is revealed in coincidence measurements and confirmed by calculations.

We present here a combined experimental and theoretical study of the influence of post-collision interaction (PCI) on the line shape of Auger photoelectrons emitted after 3*s* photoionization in Potassium. Emission of a 3*s* photoelectron leads to the creation of a 3*s* vacancy. The coupling of this vacancy with the outer 4*s* electron can form two different intermediate states of the K^{+*} ion: $3s^{-1}4s$ (^3S) or (^1S). These states differ energetically by 0.36 eV and have different widths, respectively 97 meV and 287 meV. Auger decays of these intermediate states lead to the final ionic states K^{2+} $3p^{-1}4s^{-1}$ ($^2P_{3/2}$) and ($^2P_{1/2}$) and to the emission of Auger electrons of ~5eV. Due to the small energy separation of the (^3S) and (^1S) intermediate states, the spectrum of the emitted Auger electrons shows overlapping contributions from each state.

From the other side it is known that the spectra of the low energy photoelectrons emitted from the inner shells and the Auger electrons are distorted by PCI [1] which is reduced in our case to the interaction between the photoelectron and Auger electron and to the interaction of the photoelectron with the ionic field which varies during the Auger decay. Hence both the PCI distortion and the contributions from two intermediate states affect the observed Auger electron energy distribution.

Experiments were done at the PLEIADES beam line of the SOLEIL synchrotron. A magnetic bottle time of flight spectrometer [2] was used to detect in coincidence the 3*s* photoelectron and the Auger electrons. This method allows us to select precisely the processes under study and to define the final ionic state. Our measurements cover the region of incident photon energies of ~ (1-7) eV above the threshold. We have calculated the spectra of the emitted Auger electrons taking into account the PCI effects within the semi classical [3] and quantum mechanical [4] models.

Both measurements and calculations show a significant distortion of the Auger electron spectrum. As an example we show in Figure 1 two spectra for the photon energy of 42.0 eV and the final ionic states ($^2P_{3/2}$) and ($^2P_{1/2}$). The line maxima are shifted and the contributions from the different intermediate states are distorted differently due to the large difference of their widths. The good agreement between measured and calculated energy distributions demonstrates the validity of our PCI approach.

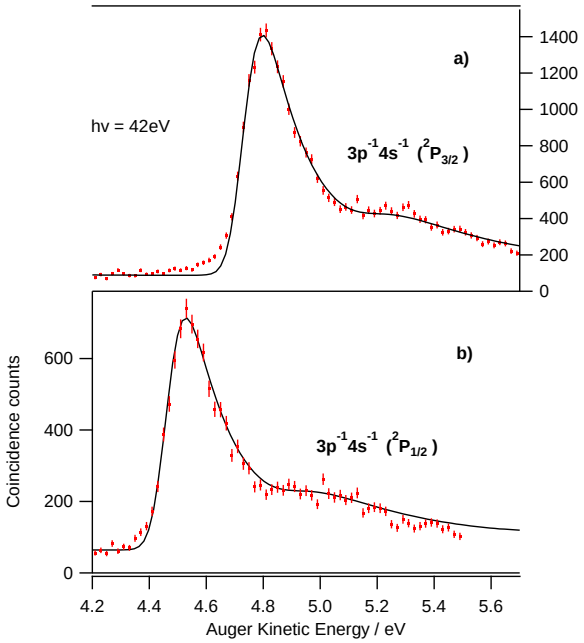

Figure 1. Auger spectra for the decay of the 3s hole, obtained at a photon energy 1.3eV above the $3s^{-1}$ (^3S) threshold. Red bars are experimental data, black lines are semi classical calculations. a) and b) select the different K^{2+} final states.

References

[1] M. Yu. Kuchiev and S. A. Sheinerman 1989 *Sov. Phys.- Usp.* **32** 569
[2] F. Penent *et al* 2005 *Phys. Rev. Lett.* **95** 083002
[3] P. van der Straten *et al* 1988 *Z. Phys. D* **8** 35
[4] M. Yu. Kuchiev and S. A. Sheinerman 1988 *J. Phys. B* **21** 2027