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Electron correlation in Xe 4d Auger decay, studied by photoelectron – Auger electron coincidence spectroscopy

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Innershell ionisation creates highly excited states that decay generally by emission of secondary Auger electrons. This schematic two step description fails when electron correlation is important as it is the case near threshold when the photoelectron escapes with a low velocity. Post Collision Interaction then plays a crucial role: it involves interaction between the 2 released electrons in the presence of the changing ion field. Emission of 0 eV or threshold electrons is a very sensitive tool to observe PCI properties, but has been only partially understood. We demonstrate, on the Xe 4d case [1], that an experiment where the Auger electron and the photoelectron are detected in coincidence enables one to define precisely the system and to clarify the process.

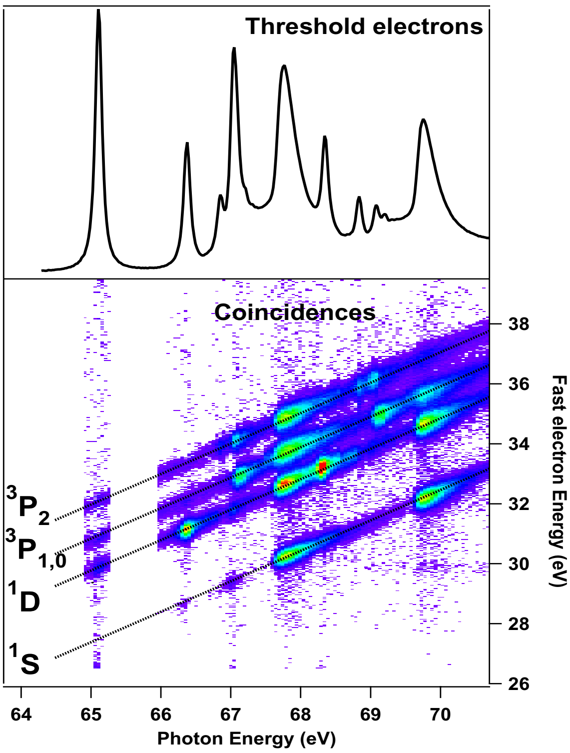

Figure 1. Top: yield of threshold electrons in the vicinity of the Xe 4d threshold. Bottom: two-dimensional map of the coincidence between threshold electrons and fast electrons whose energies are reported on the y axis.

The experiment was performed at undulator beamline BL16B, on our set up combining a threshold electron selector and a hemispherical electrostatic analyzer [2]. Figure 1 demonstrates that the coincidence method allows the decomposition of the threshold electron yield into partial channels associated to well defined Xe^{2+} $5p^{-2}$ final states. Strong PCI distortion of electron spectra are observed in all channels, and differ strongly from one another. Comparison with calculations carried out in the framework of a quantum mechanical PCI model allows us to clarify the dynamics of threshold electron production. For instance, in the $5p^{-2}$ (^1S) channel, the main contribution comes from the PCI retardation of slow photoelectrons -see Figure 2- while for the $5p^{-2}$ (^1D) final state, an additional contribution is observed on *4dnp* resonances, that comes from the recapture of the photoelectron into discrete states of the $5p^4$ (^1S) channel followed by valence multiplet decay.

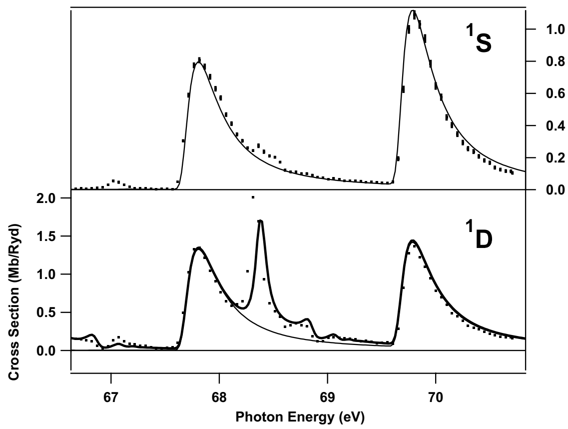

Figure 2. Comparison between partial threshold electron yields from figure 1 (dots) and theoretical calculations, thin lines show only retardation of the photoelectron, thick lines include also capture processes.

References

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