

Auger decay of the $4d^9 5s^2 5p n f$ excited states of Xe^{5+} ion

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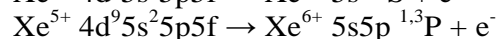
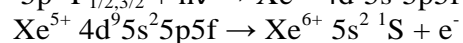
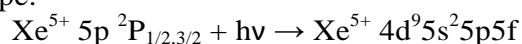
Synopsis The Auger decay of the $4d \rightarrow n f$ ($n = 4$ to 6) photoexcitations in Xe^{5+} ion has been measured using electron spectrometry. MCDF calculations allow to interpret the recorded electron spectra.

Photoionization (PI) of free ionic species is a key process for plasmas modeling. Up to now, laboratory studies on multiply-charged ions were limited mainly to photoabsorption[1] and ionic spectrometry[2] experiments. Merged-beam setups in synchrotron radiation (SR) facilities provide absolute PI cross sections. Electron spectroscopy on ionic species is still a challenge due to the low target density. Its feasibility was demonstrated in the 90's on singly-charged atomic ions[3,4]. Since that time, only the high photon flux available at free electron lasers had allowed the observation of photoelectron spectra[5]. We present here the results of the first electron spectroscopy study performed on multiply-charged ions. The Auger spectra emitted in the decay of the $4d^9 5p 5s^2 n f$ resonances in Xe^{5+} ion, with $n = 4$ to 6 , have been recorded.

The experiment was performed with the merged-beam setup of the PLEIADES beam line at SOLEIL French SR facility[6]. The Xe^{5+} ions were produced in an electron cyclotron resonance ion source (ECRIS). A cylindrical mirror electron analyzer (CMA), with its axis collinear to the ions and SR counter propagating beams, analyzed the kinetic energy of the electrons emitted in coincidence with the Xe^{6+} ions.

The Figure 1 shows an example of electron spectrum recorded at the photon energy of the $4d^9 5s^2 5p 5f$ resonance (108.6 eV, upper panel). The Xe^{5+} ions are produced in the ECRIS in the $5p^2 P_{1/2}$ ground level and $2P_{3/2}$ metastable level. At this photon energy, resonances from both levels can be excited. At least four lines are observed and can be identified with the help of multi-configuration Dirac Fock (MCDF) calculations. The calculated electron spectrum (lower panel) is reconstructed assuming a 45% $2P_{1/2}$ and 55% $2P_{3/2}$ population and is convoluted with a Gaussian profile simulating the experimental broadening of the electron lines. All the lines

are issued from resonant PI processes of the type:



The good agreement between experimental and theoretical spectra shows that at this energy mainly Xe^{5+} ions in the $2P_{3/2}$ metastable level are excited, and that the main decay channel leads with equal intensity to the $5s^2 {}^1S_0$ ground level (main line at 44 eV kinetic energy) and to the $5s 5p^3 {}^3P_2$ excited level of Xe^{6+} ion (satellite line observed at 30 eV).

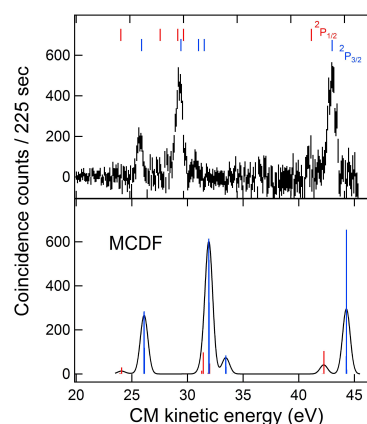


Figure 1. Electron spectrum recorded at 108.6 eV photon energy (top panel) compared to the reconstructed MCDF theoretical spectrum (bottom panel).

References

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