The emergence of Rydberg series in the Auger satellite spectrum by photoelectron recapture through post-collision interactions in Xe


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Post-collision interactions (PCI) effects can manifest conspicuous effects in the photoelectron and Auger electron spectra, particularly in the photon energy region close to the photoionization threshold. Upon photoionization, PCI effects are normally manifest in the shift and distortion of the photoelectron line (towards lower energy) and Auger electron line (towards higher energy. However, in the extreme case, the photoelectron can be recaptured by the ionic core. Rydberg series structures formed as the result of this mechanism were observed previously Ar [1](ion time of flight) [2](electron spectroscopy), Ne [3] and N₂ [4] and discussed theoretically [5]. Here we examine the continuous PCI tail formed on the high energy side of the Auger satellite line gradually transforming into discrete Rydberg series. High resolution spectra of Xe 4d₅/₂ ionization were obtained by photoelectron spectroscopy utilizing synchrotron radiation at the Advanced Light Source, Berkeley. Figure 1 shows the spectrum taken with photon energy very close to the 4d₅/₂ threshold with clear Rydberg series formed in the higher energy side of the peaks. On the other hand, Figure 2 shows data taken at somewhat higher photon energies where the discrete series structure vanishes, replaced by a continuous tail. Figure 2 also vividly shows the characteristic of PCI effect, that the lower photon energies lead to longer tails.

Figure 1: Electron energy spectra when photon energies are 66.798 eV and 68 eV. 66.798 eV is under 4d₅/₂ ionization threshold, 67.548 eV. And 68 eV is above this threshold closely. Under the threshold we cannot see any Auger spectra regarding 4d₅/₂ ionization

Figure 2: Electron energy spectra when photon energies are 72.4 eV and 74.4 eV. Rydberg series are not appear in these spectra. Only PCI tails can be observed.

[2] A. De Fanis et al., 2004 Physical Review A 70 040702