

T499 : Test Experiments for Measurements of Electronic X rays Following Pion Capture Process

Our group has been studying the pion capture process for molecules in the liquid and gas phases focusing to the behavior of pionic hydrogen atoms to understand the mechanism of the process. The experimental results revealed the influence of the valence electrons and chemical structure on the pion capture and pion transfer processes. It is necessary for further understanding the mechanism to observe directly the initial step of the capture process and to investigate microscopically the whole of the capture process. Then we are designing an experiment to measure Auger electrons emitted in the initial step of the pion capture and electronic X rays (eX rays) in the coincidence with the pionic X rays (π X rays). In the first step, we are making an experimental plan to measure the eX rays correlated with individual π X-rays, to reveal rearrangement of inner-shell electrons. In T499, we made the test experiments to measure the eX-rays to design the setup for the correlation measurement.

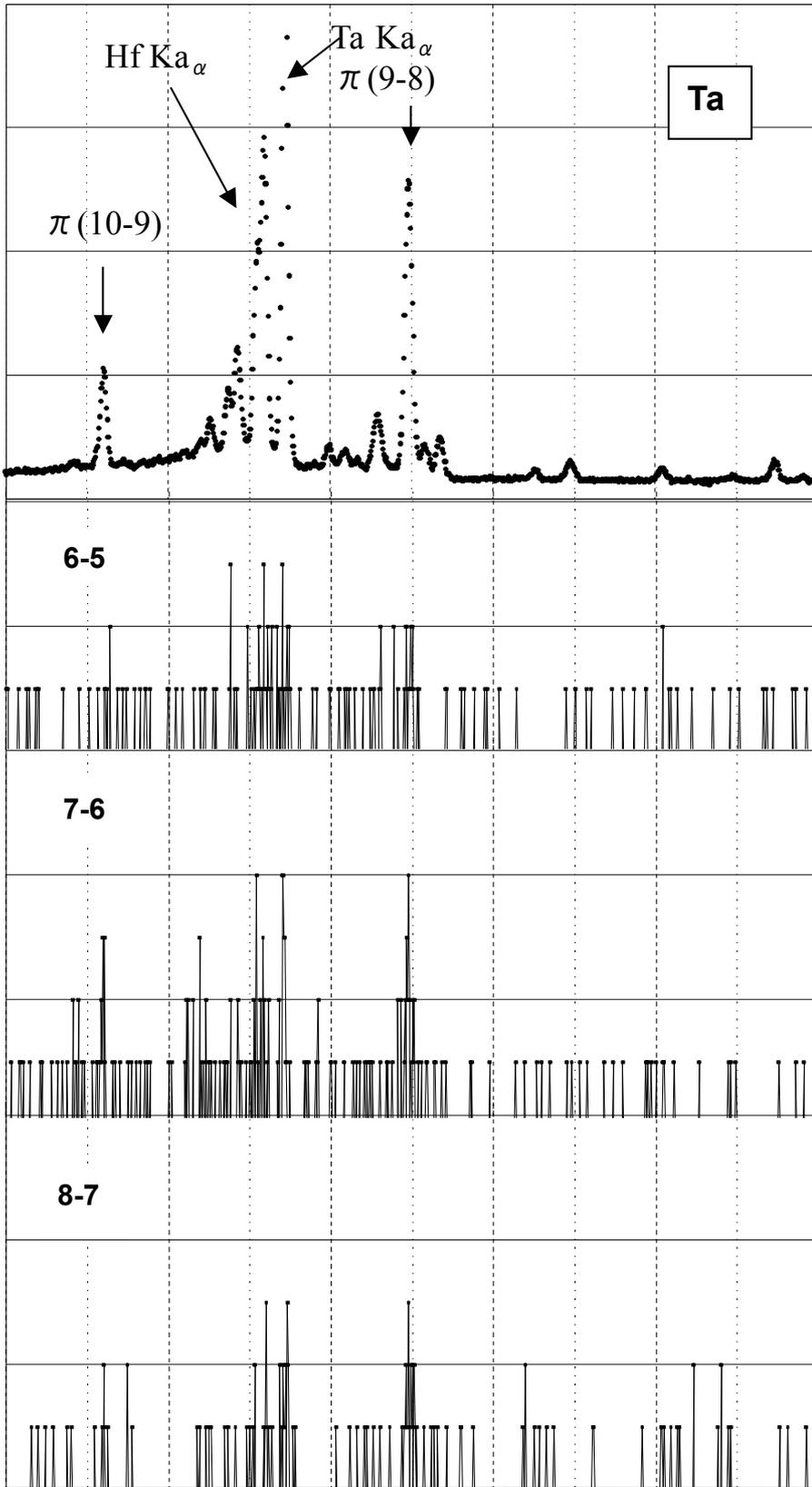
The measurements were performed at the $\pi \mu$ channel of KEK-PS. The eX rays and π X rays were measured with a pair of Ge-detectors for low-energy photon spectrometry. According to the results of the previous test experiments (E465 & T480), we improved the experimental setup and carried out the correlation measurement between the eX and π X rays.

- Evaluation of the various kind of the shield & construction of the setup for the correlation measurement.
- Test measurements of eX rays for Ag, Ta, and Pb targets.
- Long term measurements for Ta target.

Consequently, the eX-rays for (Z-1) atom of the atomic number were observed in the coincidence of the π X rays, though the statistics were very low. Figure 1 is an example of the X-ray spectrum observed in the coincidence with the π X-rays. Now we are designing the shield and measuring chamber to lower the influence of the secondary electrons and bremsstrahlung, and developing a new detection system to measure the low energy eX rays with higher detection efficiency.

Figure Caption

Fig.1. Pionic and electronic X-ray spectra for Ta target. The photon spectrum in the region of the electronic X rays and the electronic X-rays observed in the coincidence with the pionic X-rays of Ta(6-5), Ta(7-6) and Ta(8-7). The numbers in parentheses indicate the principal quantum numbers relevant to the pion-atomic transition.



Energy(keV/20ch)