4 - 11 Double *K*-shell Ionization of Ar by 197-MeV/u Xe^{54+} Ion Impact

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The K X-rays of multiply ionized argon atom were measured in single collisions of 197-MeV/u Xe^{54+} ions with an argon gas target. The measured X-ray spectrum includes the $K\alpha$ satellite ($K\alpha^s$), $K\beta$ satellite ($K\beta^s$), $K\alpha$ hypersatellite ($K\alpha^{h,s}$) and $K\beta$ hypersatellite ($K\beta^{h,s}$) lines, as shown in Fig. 1. The double K-shell ionization processes of argon atoms are investigated by means of the intensity ratios $I(K\alpha^{h,s})/I(K\alpha^s)$ from a fitting model, combining with the evaluation of the fluorescence yields of the multi-vacancy state atoms and vacancy rearrangement processes. The relative yield of double K-shell vacancies with respect to single K-shell ionized ones was determined to be 12%. The experimental cross section ratio reaches a reasonable agreement with the calculated value from the relativistic time-dependent two-center theory. However, the mean number of the spectator L-vacancies extracted from the experiments is a number that nearly one less than that of the theory. For detailed discussion of discrepancy between the theoretical and experimental results, please refer to the published paper[1]. The present results indicate the feasibility of experiments with higher energy resolution, which are expected to provide a more stringent test of the theory in ion-atom and also the possibilities to investigate exotic decay modes such as two-electron one-photon (TEOP) transitions.

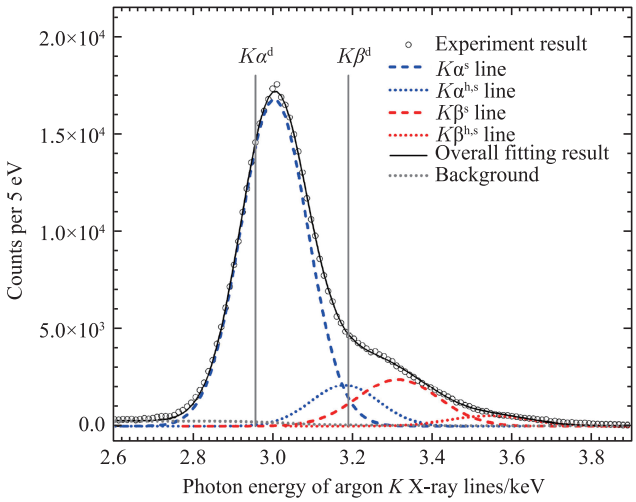

Fig. 1 (color online) Spectrum of X rays emitted from argon target in the collisions with 197-MeV/u Xe^{54+} ions, obtained by the Si(Li) detector at the 90° observation angle. The measured data are represented by open circles, while the fitted transitions are represented by dashed curves. The fitted background is shown as gray dotted line.

Reference

[1] C. J. Shao, Atoms, 10(2022)155.