Abstract preparation for Workshop on "Cascade and direct double Auger decay of K-shell hollow states of Ne^+"

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Hollow states are unique species in which two inner-shell electrons are removed [1, 2]. With the development of X-ray free electron lasers, hollow states can be readily produced by the interaction of ultra-intensive X-ray pulses with matter, including atoms, molecules, clusters, and solids. To investigate the interaction of X-ray lasers with matter and the spectroscopy of hollow states, a lot of atomic data are required, including the Auger decay rates. Determination of accurate Auger decay rates of hollow states is in general challenging both experimentally and theoretically. Theoretically, it is difficult to properly and accurately describe the wave functions of hollow states. The lifetime of hollow states is very short, and hence experimental investigation to obtain high-resolution signals is difficult.

In this study, we theoretically investigated single and double Auger decay processes from the $K^{-2}V$ ($V = 3s, 3p, 3d, 4s, 4p, 4d$) hollow states of Ne^+ in the framework of the first- and second-order perturbation theory implemented by the distorted wave approximation. For the double processes, both cascade and direct double Auger decays were studied in detail. The direct double Auger decay rates were calculated based on the separation of knock-out and shake-off mechanisms [3]. Atomic data, including the transition energy, single and double Auger decay rates, and natural lifetime width, were obtained and compared with the experimental and theoretical results available in the literature. The natural lifetime widths of the $K^{-2}V$ hollow states, including the contributions from single and direct double Auger decay, are in excellent agreement with a recent experiment[4, 5].

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