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Calculation of Cascade Processes rates and Simulation of the Transitions in Kaonic 4He atom

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Calculation of Cascade Processes rates and Simulation of the Transitions in Kaonic 4He atom

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Investigation of cascade processes of kaonic atoms is very important to analyze theoretical and experimental studies of K-nucleon strong interaction in low energies. Several experiments have been carried out to detect precisely the x-ray yields of K-p, K-d and K4He atoms [1-4]. We studied the x-ray yields of K-p and K-d atoms previously [5-7]. In this paper we have calculated the cascade processes rates in K4He atoms by a full-quantum mechanical approach, then the cascade processes and x-ray yields in liquid and gaseous helium targets are simulated by Monte-Carlo method.
After K4He atom formation, it is ionized by internal Auger effect, then the K-alpha+ starts the cascade processes from a new n, l distribution. Therefore in order to start the simulation, the initial n, l distribution in K4He atom formation and then in K-alpha+ ion are needed. For this purpose we have used a time dependent perturbation theory to calculate K4He formation atom and internal Auger process. We have shown that the initial n states of K4He and K-alpha+ have a broad distribution around n=29 and n=25, respectively. Then the rates of the cascade processes for K-alpha+ atom are calculated. For this purpose we have used time dependent perturbation theory without any semiclassical approximations or any free parameters. For the full-quantum mechanical calculations, analytical and numerical voluminous calculations should be done for many transitions. The values of the cascade processes rates are compared with each other and their effects are analyzed. Then the calculated rates were used in our code for simulating the cascade processes.
Number of the absorption in low l levels, Stark mixing, x-ray yields and other kinds of transitions are calculated by our simulation. Comparing the simulated x-ray yields in gaseous and liquid helium targets gives some interesting results which are presented in the conference.
Finally, we have compared the density dependence of x-ray yields for K4He with K-p and K-d results. The calculated relative L-series x-ray yields are also compared with the results of KEK-E570 experiment [3].

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