Study of cascade processes in $p\mu^-$ and pK^- atoms based on a new approach

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A new quantum–classical Monte Carlo code (NQCMC) has been developed and applied to the calculation of the various characteristics of cascade processes in muonic and kaonic hydrogen atoms. Radiative transitions are taken into account within the framework of quantum mechanics whereas Coulomb and Stark collisions are considered by methods of classical mechanics; Auger processes are treated in a semi-classical way. Such a calculation scheme is a compromise which allows to carry out *ab initio* calculations of the physical parameters with an accuracy of $\sim 20\%$.

The kinetic energy distribution functions for muonic and kaonic atoms in excited states have been calculated, and it has been confirmed that multi-quantum $\Delta n > 1$ Coulomb transitions between atomic states appear to be the main acceleration mechanism for exotic atoms of hydrogen isotopes [1, 2].

The effect of Auger capture of "heavy" pK and "light" $p\mu$ atoms with the subsequent decay of the formed exotic molecular complex has been considered. Kaonic atoms become fast due to multi-quantum Coulomb transitions just after formation and therefore cannot be captured in Auger processes [3], so that processes of kaonic molecule formation by the Auger mechanism are not essential in this cascade. The results of the calculations have shown that in the case of muonic atoms, also due to Coulomb acceleration, only a small part of $p\mu$ atoms can be captured in Auger-processes, and their contribution to the values of the cascade characteristics has been estimated at about $\sim 1\%$.

The yields for the K-series X-rays in kaonic and muonic hydrogen as well as other cascade characteristics have been calculated and compared with the experimental data at different hydrogen target densities.

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