Systematic study of strange nuclear systems : unusual structures formed by a K^- meson

Akinobu Doté[a], Yoshinori Akaishi[a] and Toshimitsu Yamazaki[b]

[a] *High Energy Accelerator Research Organization (KEK), Ibaraki 305-0801*
[b] *The Institute of Physical and Chemical Research (RIKEN), Saitama 351-0198*

Stable nuclei have been considered to have following properties : 1) They are incompressible with saturated density like liquid drop, and 2) proton's distribution is almost the same as neutron's. Here we point out that these fundamental properties are no longer held when a K^- is injected into a nucleus. According to our previous study[1] with the method of Antisymmetrized Molecular Dynamics (AMD), ppnK^- and ^{8}BeK^- are found to be deeply-bound and discrete states with 105MeV and 104MeV bindings, respectively. Their structures are of unexpected features. Especially, ^{8}BeK^- is so shrunk that its central density amounts to 4.5 times the normal density ρ_0. In addition, proton's distribution is considerably different from neutron's one in spite of $N = Z$ ("isovector deformation" is induced). A K^- can drastically change the properties of usual nuclei : Due to strong K^-p attraction, 1) nuclei are easily compressed, and 2) protons are separated from neutrons in a nucleus.

Now, we investigate various kaonic nuclei systematically with a new framework of AMD, where we can treat the "K^--$\overline{K^0}$ mixing" and perform "angular momentum & isospin projections" for the first time. Our purposes are to reveal the binding mechanism of kaonic nuclei and to find structures inherent in them. Figure 1 demonstrates our latest results, which are nucleon-density distributions of ppnK^-, pppK^-, pppnK^- and ^{6}BeK^-. It is shown that the kaonic nuclei have peculiar condensed structures we have never seen in ordinary nuclei. The binding energies and decay widths of these kaonic nuclei are (110.3, 21.2), (96.7, 12.5), (105.0, 25.9) and (104.2, 33.3), respectively, which can be used to examine the feasibility of the experimental detection. We are going to obtain some results of "double kaonic nuclei" which contain two K^-'s. They seem to be a gateway to kaon condensation and strange quark matter.

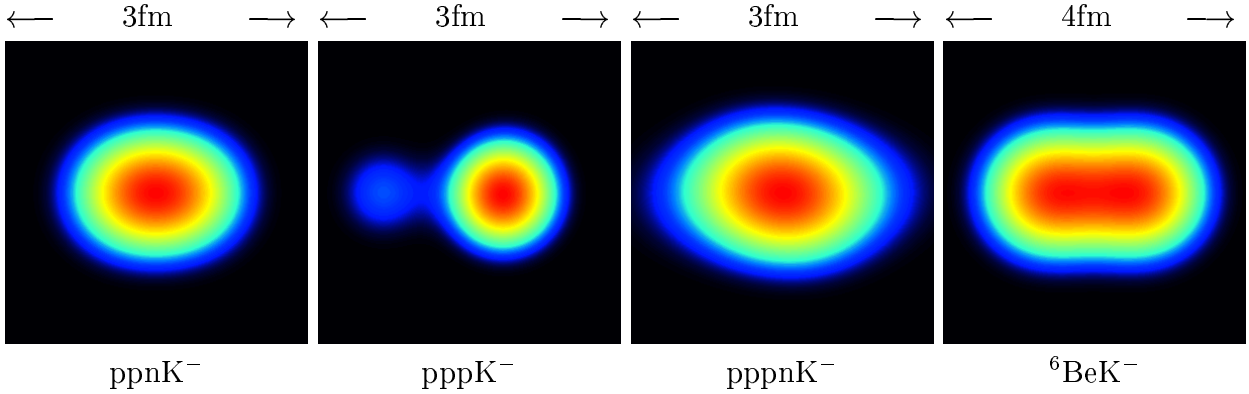

Figure 1: Density distributions of various kaonic nuclei.

References

[1] A. Doté, H. Horiuchi, Y. Akaishi and T. Yamazaki, proceedings of YKIS'01.