E471: Search for deeply bound kaonic state

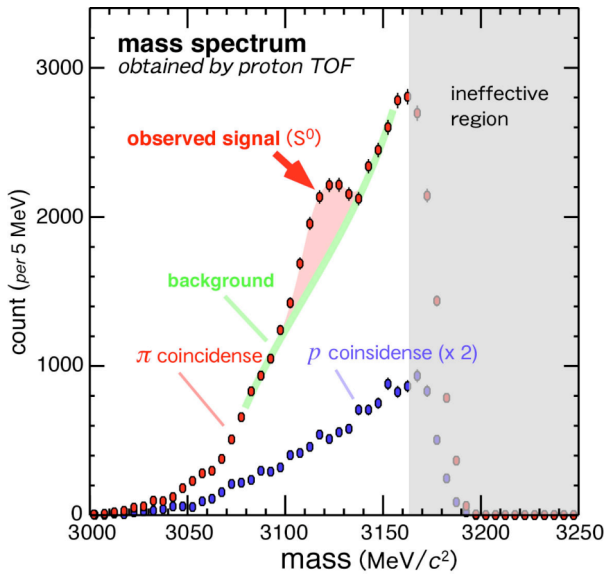*RIKEN-U.Tokyo-SNU-CMU-TITech-KEK*

    We have discovered a totally new object, which consists of K⁻ pnn, named as strange-tribaryon S^0, as shown in the Fig. 1.   The experiment (PS-E471) was performed at K5, using absorption-reaction of negative kaon at-rest in a helium-4 target.

    The highest density material (excluding the astrophysical system) is the nuclei, which consists of protons and neutrons, combined by the meson exchange force, and it is known that the densities of nucleus are universal and constant. The present finding can be understood by the theoretical prediction, given by Akaishi and Yamazaki, that the nuclear matter can shrink by the strongly-attractive interaction between kaon and nucleon (proton and neutron), and extremely high-density system can be formed spontaneously (shown in Fig. 2).   In the other word, K-meson is a catalytic agent to form high-density matter in nucleus.

    Presently, it is widely accepted that the mass of hadron (member of elementary particle, which consists of quarks) are formed and defined by the nature of medium surrounding the particle. Therefore, present finding indicating a totally new research field to study the "nature of mass formation" as a function of medium density. It can also possible to study astrophysical study, such as the nature of the physics in the core of neutron star, in a laboratory experiment.

(Left)

Fig. 1 The missing mass spectra obtained by the ^{4}He(*stopped K⁻, p*)S^0 reaction, obtained by the time-of-flight analysis of the emitted proton.

(Bottom)

Fig. 2 Calculated density distribution of nucleon center by the AMD method, given by Dote et al. Left panel shows the normal nucleon density for *ppn*, namely ^{3}He. Originally predicted kaon contracted system is shown in center panel, whose isospin is T=0. Right panel shows its isospin partner (T=1), which is considered as a candidate of the present findings.