Improved $^3\mathrm{He}\,(K^-, \Lambda p)\,n$ spectroscopy to search for the $\bar{K}NN$ bound state with J-PARC E15$^{2\mathrm{nd}}$ data

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Studying for a bound system of a nucleus and an anti-kaon, so-called kaonic nucleus, is an important subject to understand the $\bar{K}N$ interaction in the energy range below the $\bar{K}N$ threshold. There are many studies to search for kaonic nucleus by both theoretical and experimental approaches. However, the binding energy, decay width and even its existence have not been established yet, even for the simplest kaonic nucleus, a $\bar{K}NN$ bound state.

Therefore, we have investigated the $\bar{K}NN$ bound state via the in-flight (K^-, n) reaction on a liquid helium-3 target with the incident kaon momentum of 1.0 GeV/c at J-PARC. A detector system has an acceptance to detect not only emitted neutron but also decay particles, so that we can identify the final state and reconstruct full kinematics of the reaction. Our result, on a missing-mass measurement of the $^3\mathrm{He}\,(K^-, n)$ reaction with our first physics data taken in 2013, show that there is a long tail below the K^-pp mass threshold. A peak structure was observed close to the threshold, in the exclusive analysis for the Λpn final state, where Λp considered as one of the decay final state of the $\bar{K}NN$ state.

To understand the origin of the observed peak structure, we carried out our second physics data-taking in the end of 2015, E15$^{2\mathrm{nd}}$. We have successfully accumulated several tens of more data for the exclusive $^3\mathrm{He}\,(K^-, \Lambda p)\,n$ events than those in 2013. In this paper, preliminary analysis on the exclusive measurement with much improved statistics will be presented.