Search for Exicted State of Σ Hypernucleus in the J-PARC E13 Experiment

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The NN interaction has been studied through structure of nuclei and NN scattering experiments. On the other hand, the YN interaction is not understood precisely yet. The main reason of the difficulty of the YN interaction study is that YN scattering experiments are difficult due to short lifetime of hyperons ($c\tau \sim$ few cm). Instead, the YN interaction has been studied through the structure of hypernuclei. Amoung these studies, the ΛN interaction is relatively well established. On the other hand, the ΣN interaction is poorly understood. The bound state of the ${}^{4}_{\Sigma}$He hypernucleus (Σ is in the s-shell orbit) is the only rigid information of the ΣN interaction[1].

A bump structure of ${}^{4}_{\Sigma}$He hypernucleus was observed by the KEK-PS E167 collaboration in 1989[2]. Then, more clear signal of the ground state of ${}^{4}_{\Sigma}$He hypernucleus was observed by the BNL E905 collaboration in 1998[3]. The property of the ΣN interaction was extracted from structure of the ground state for which Σ hyperon stayed in the s-shell orbit. Previous studies of the Σ hypernuclei have been done mainly to search for ground states. Thus, the low beam momenta ($\sim$0.6 GeV/c) were employed to minimize the momentum transfer of the (K^-, π^-) reaction. To obtain information of the excited states for which the Σ hyperon is in higher shell-model orbits, higher beam momenta are usefull to introduce larger momentum transfer[4].

We performed the J-PARC E13 experiment to search for excited states of ${}^{4}_{\Sigma}$He hypernucleus via the ^{4}He(K^-, π^-) reaction at 1.5 GeV/c in 2015 spring[5]. 23×10^9 kaon beams were injected on 3.0 g/cm^2 of a liquid ^{4}He target in the experiment. In addition, in order to calibrate the beam and ejectile momenta, we measured the $K^- + p \to \pi^- + \Sigma^+$ reaction with a 3.0 g/cm^2 of CH_2 target.

We would like to report results of preliminary analyses.

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