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"Spectroscopic study of Kaonic nuclei using inclusive and exclusive $^{12}\mathrm{C}(K^-, p)$ reaction at J-PARC"

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It has been argued that the formation of a molecular-like quasi-bound state, $\Lambda(1405)$, arises from the strong attraction between $\overline{K}N$ with isospin I = 0 channel. Furthermore, its strong attraction suggests the existence of kaonic nuclei in a three-body system, K^-pp, as well as in more complex many-body systems.

Some calculations suggest existence of various types of many-body systems involving Kaon and nucleons. However, apart from the observation of the K^-pp three-body system[1][2], there have been few clear confirmations for the existence of Kaonic nuclei. Therefore, it is crucial to systematically investigate Kaonic nuclei across a wide range of mass numbers not only for understanding $\overline{K}N$ interactions but also for obtaining information on the presence or absence of $\overline{K}$ within the inner core region of neutron stars.

The J-PARC E05 experiment studied the interaction between $\overline{K}$ and a residual nucleus by measuring an inclusive $^{12}\mathrm{C}(K^-, p)$ spectrum. From the analysis, the depths of both the real and imaginary parts of the $\overline{K}$-nucleus optical potential were obtained to be (-80, 40) [MeV] by fitting the shallow bound region with a theoretically calculated spectrum[3]. In addition, a significant event excess was observed in the spectrum in the deeply bound region around 90 MeV in the $\overline{K}$ binding energy. That excess fits well with a Breit-Wigner function whose binding energy is 90 MeV and width is 100 MeV, suggesting possible contribution from production of $\overline{K}NN$ or a bound state between an excited hyperon (Y^*) and a nucleus.

To investigate the reason behind the excess event, we conducted a new experiment called E42[4]. This experiment used the same reactio dibaryon search experiment. We used a GEM-based Time Projection Chamber, HypTPC, installed around the target to measure the decay-charged particles during this experiment. This measurement technique helped improve the signal-to-noise ratio and allowed us to detect the Y^* nuclear state as a clear bump if it exists.

In this talk, we will summarize the E05 results and report preliminary results of the inclusive $^{12}\mathrm{C}(K^-, p)$ spectrum and the exclusive analysis using the information on particle identification with HypTPC.

Reference
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[2] T. Yamaga *et al.* Phys. Rev. C **102**, 044002 (2020)
[3] Y. Ichikawa *et al.*, PTEP **2020**, 123D01 (2020)
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session

J. Strange Nuclear Systems

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