Structure of few-body antikaon-nuclear bound states with the two-body $\bar{K}$ absorption

Ryosuke Komiya[1*], Mao Kurino[1], Junko Yamagata-Sekihara[1], Takayasu Sekihara[2]

[1]Kyoto Sangyo Univ., [2]Kyoto Prefectural Univ.

Content

Understanding the properties of mesons in the nuclear medium is one of the most important subjects in hadron physics, as it is deeply related to the spontaneous breaking and restoration of chiral symmetry in QCD (quantum chromodynamics). Many studies have been conducted on meson-nucleus systems. In particular, few-body bound states are suitable for investigating such systems from the microscopic perspective of the meson-nucleon interactions.

Among various meson-nucleus systems, the antikaon $(\bar{K})$-nucleus system is interesting, as the strong attraction of the $\bar{K}N$ interaction is expected to bind the system and may change the structure of the nucleus. For this reason, both experimental and theoretical studies have been performed so far. Eventually, the so-called K^-pp bound state was observed in the J-PARC E15 experiment [1,2], with the binding energy of 42 ± 3 MeV and decay width of 100 ± 7 MeV. On the other hand, the decay width of $40 - 70$ MeV [3,4] was predicted in the theoretical calculations for the K^-pp bound state, in which, however, the two-body $\bar{K}$ absorption has been not taken into account.

In this study, we focus on the structure of the $\bar{K}NN$ system with the two-body $\bar{K}$ absorption (Fig. 1) from the theoretical point of view. We use the Stochastic Variational Method (SVM) [5,6], which is suitable for describing well the structure of few-body systems, particularly the ground-state binding energy, through the use of random Gaussian basis functions. Using the SVM, we investigate how the two-body $\bar{K}$ absorption affects the structure of the $\bar{K}NN$ system, including its binding energy and decay width.

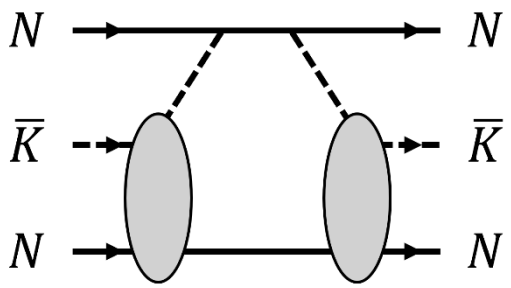

Figure 1. Feynman diagram of the two-nucleon absorption process in the $\bar{K}NN$ system.

Reference

[1] S. Ajimura *et al.* [J-RARC E15], Phys. Lett. B **789**, 620 (2019).
[2] T. Yamaga *et al.* [J-PARC E15], Phys. Rev. C **102**, 044002 (2020).
[3] A. Doté, T. Hyodo and W. Weise, Phys. Rev. C **79**, 014003 (2009).
[4] N. Barnea, A. Gal and E. Z. Liverts, Phys. Lett. B **712**, 132 (2012).
[5] S. Ohnishi, W. Horiuchi, T. Hoshino, K. Miyahara and T. Hyodo, Phys. Rev. C95 065202 (2017).
[6] K. Varga and Y. Suzuki, Phys. Rev. C **52**, 2885 (1995); Comput. Phys. Commun. **106**, 157 (1997).

Field of Research: Interactions of mesons and baryons with strangeness / Strange mesons in nuclei
Experiment / Theory: Theory
Contribution Type: Contribution talk