Theoretical study of a prototype system of kaonic nuclei “K^-pp”

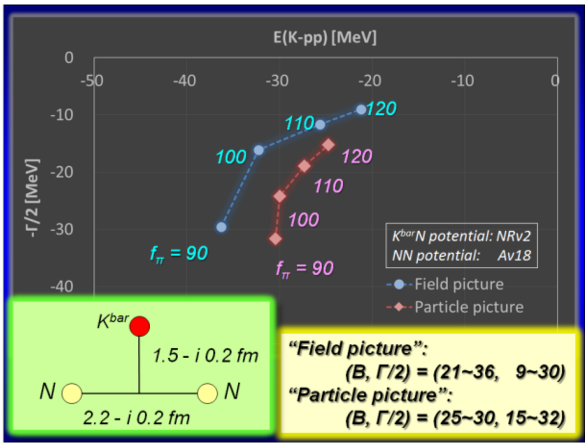
A. Doté[1#], T. Inoue[2], and T. Myo[3]

[1]*KEK Theory Center, IPNS, KEK, 1-1 Oho, Tsukuba, Ibaraki, 305-0801, Japan*
[2]*Nihon University, College of Bioresource Sciences, Fujisawa 252-0880, Japan*
[3] *Osaka Institute of Technology, Osaka, Osaka 535-8585, Japan*

 # a corresponding author: E-mail dote@post.kek.jp

In strange nuclear physics and hadron physics, kaonic nuclei (nuclear system with anti-kaons (K^{bar})) have been a hot topic since the formation of dense state are interestingly expected due to the strong $K^{bar}N$ attraction. To reveal the nature of kaonic nuclei, which could be an exotic system, lots of efforts have been devoted to the study of a prototype system of kaonic nuclei, “K^-pp”. Especially, now is the very exciting time because new experimental results are being reported from two groups of J-PARC (E15 and E27). We are theoretically investigating the K^-pp with a coupled-channel Complex Scaling Method (ccCSM) which was proposed in our previous work [1]. This method can treat simultaneously coupled-channel problem and resonance problem which are important ingredients in the study of K^-pp. Recently, we have developed a handy method, so-called ***ccCSM+Feshbach method***. The K^-pp is actually a coupled-channel system of $K^{bar}NN$- $\pi\Sigma N$- $\pi\Lambda N$. However, we can treat it as a single-channel problem of $K^{bar}NN$ by a *tricky* use of ccCSM.

As a result of careful calculation with the ccCSM+Feshbach method using an energy-dependent potential based on chiral SU(3) theory [1], we find that the K^-pp is not so deeply bound with ~30 MeV binding. The decay width depends on a parameter and ansatz for the treatment of energy dependence; 20~60 MeV. Analyzing the ccCSM wave function, we find that the mean distance of two nucleons in the K^-pp is found to be ~2.2 fm which is almost equal to the *NN* distance in normal nuclear matter. (In the figure, a result obtained with non-relativistic kinematics is shown.)



In the talk, we will report further results obtained with other versions of $K^{bar}N$ potential and those in the semi-relativistic kinematics. We hope to discuss on comparison of our result and the J-PARC experimental results.

Reference

[1] A. Doté, T. Inoue and T. Myo, Nucl. Phys. A912, 66 (2013).