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Insights into the $\bar{K}N$ interaction and $\Lambda(1405)$ through model analysis of HAL QCD results

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Hadron-hadron interaction has been one of the most important topics in hadron physics, because it contains information on the quark dynamics inside hadrons, which will be a hint to understand the fundamental theory of strong interaction, quantum chromodynamics (QCD). Among various pairs of two hadrons, the $\bar{K}N$ system is one of the most interesting. It is well known that the $\bar{K}N$ interaction is strongly attractive and, as suggested in the chiral unitary model [1], dynamically generates the $\Lambda(1405)$ resonance.

Hadron-hadron interaction has been studied in lattice QCD simulations as well. In particular, the HAL QCD method has been established as a reliable method to study hadron-hadron potentials [2]. However, in the $\bar{K}N$ potential, singular behavior around the origin has been observed in the HAL QCD method [3]. In order to clarify the cause of such behavior in the HAL QCD method, we calculate the R-correlators and local potentials in an effective model of hadron-hadron interaction and compare it with the $\bar{K}N$ potential in the HAL QCD method.

[1] Hyodo and Jido, Prog. Part. Nucl. Phys. 67 (2012) 55.
[2] S. Aoki et al. [HAL QCD], Prog. Theor. Exp. Phys. 2012 (2012) 01A105.
[3] K. Murakami and S. Aoki, PoS LATTICE2023 (2024) 063; PoS LATTICE2024 (2025) 101.

Collaboration

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