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$\Lambda_c - N$ interaction form Lattice QCD at physical point

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We investigate $\Lambda_c - N$ interaction in the spin singlet channel ($^1S_0$) and the spin triplet coupled channel ($^3S_1 - {}^3D_1$) from lattice QCD by using HAL QCD method. We perform the first physical point simulation by employing gauge configurations generated by the HAL Collaboration at $m_\pi \simeq 137$ MeV, $m_K \simeq 502$ MeV, and $a \simeq 0.0844$ fm on 96^4 lattices (HAL-Conf-2023) in which a high statistical precision was achieved by 8000 Monte Carlo trajectories. Our calculations of the $\Lambda_c - N$ potential show a weak mid-range attraction and a short-range repulsive core. This is qualitatively similar to the results obtained in our previous calculations at heavier pion masses, $m_\pi \simeq 410,\ 570,\ 700$ MeV, while the current results at the physical point indicate a shallower mid-range attraction compared to the previous results. With the ALICE upgrade for LHC Run-3, which aims for a fifty-times increase in recorded collisions, the increased statistics of charm baryons may enhance the feasibility of the measurements of $\Lambda_c - N$ femtoscopic correlations, making it possible to analyze the $\Lambda_c - N$ interaction by both lattice QCD and experimental data. The present results at the physical point with the coupled-channel effect would also make a significant impact on the studies of $\Lambda_c - N$ interactions based on chiral effective field theory.

Category

Theory

Collaboration

HAL QCD

Author: ZHANG, Liang (Shanghai Institute of Applied Physics, Chinese Academy of Sciences; iTHEMS, RIKEN)

Co-authors: DOI, Takumi; HATSUDA, Tetsuo (RIKEN iTHEMS)

Presenter: ZHANG, Liang (Shanghai Institute of Applied Physics, Chinese Academy of Sciences; iTHEMS, RIKEN)

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