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Diquarks study from Lattice QCD

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In this work, we aim to calculate the diquark mass together with the quark-diquark potential in which we apply an extended HAL QCD potential method to a baryonic system made up from a static quark and a diquark. We consider various types of diquarks
(eg: scalar 0^+ diquark, axial-vector 1^+ diquark etc) to examine their mass differences.

Numerical calculations are performed by employing 2 + 1 flavor QCD gauge configurations generated by PACS-CS Collaborations on a L^3 \times T = $32^3 \times 64$ lattice with $m_\pi \sim 700$ MeV.

To improve the statistical noise in the static quark propagators, we also employ the HYP smearing on the gauge links.

Two-point correlators of quark-diquark baryonic system are then computed to obtain their ground-state energies and mass differences.

For the baryonic system made up from a scalar diquark and a static quark, we apply an extended HAL QCD method to study the scalar diquark mass and the quark-diquark potential where, in order to determine the diquark mass self-consistently in the HAL QCD method, we demand that the baryonic spectrum in the p-wave sector should be reproduced by the potential obtained from the baryonic system in the s-wave sector.

We obtain the scalar diquark mass of roughly (2/3) m_N, i.e., twice the naïve estimates of a constituent quark mass together with the quark-diquark potential of Cornell type (Coulomb + linear).

Author: KELVIN-LEE, Kai-Wen (Research Center for Nuclear Physics, University of Osaka)

Co-author: Dr ISHII, Noriyoshi (Research Center for Nuclear Physics, University of Osaka)

Presenter: KELVIN-LEE, Kai-Wen (Research Center for Nuclear Physics, University of Osaka)

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