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Axialvector diquark Mass and quark-diquark potential in Sigma_c

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We will present a lattice QCD study of the axialvector diquark. We note that obtaining the diquark mass from the bound-state pole of the two-point correlator is not straightforward due to color confinement. To circumvent this issue, we regard the diquark mass as a parameter in the quark-diquark model, constructed using the potential method developed by the HAL QCD Collaboration. For the axialvector diquark study, we focus on the Sigma_c system, which is treated as a bound state of a charm quark and an axialvector diquark.

Using 2+1 flavor QCD gauge configurations on a 32^3 x 64 lattice, generated by the PACS-CS Collaboration (with m_pi approximately 700 MeV), we calculate a four-point correlator of the axialvector diquark and charm quark. From this, we extract the equal-time Nambu-Bethe-Salpeter (NBS) wave function in the large t region. The HAL QCD potential method is then used to determine the quark-diquark potential between the charm quark and the axialvector diquark. We find a spin-independent central potential of the Cornell type and a spin-dependent potential resembling a smeared delta function.

To determine the diquark mass, we apply an additional condition similar to the one proposed by Kawanai and Sasaki for studying the ccbar system, which requires the spin-dependent potential to vanish at long distances. As a result, we obtain a diquark mass that tends to be small. This appears to be due to (1) poor statistics of the spin-dependent potential at long distances and (2) uncertainty in determining the charm quark mass.

Primary author: NISHIOKA, Soya (RCNP, Osaka Univ)

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

Presenter: NISHIOKA, Soya (RCNP, Osaka Univ)

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