



Contribution ID: 143

Type: Oral

Restoration of residual gauge symmetries due to topological defects and color confinement in the Lorenz, Maximal Abelian and axial-like gauges

Thursday 22 August 2024 17:10 (20 minutes)

The residual local gauge symmetry is the local gauge symmetry remaining even after imposing the gauge fixing condition. Although this symmetry is “spontaneously broken” in the perturbative vacuum, it can be restored in the true confining vacuum of QCD. Therefore, a color confinement criterion is obtained as the condition of restoration of the residual local gauge symmetry, namely, disappearance of the massless Nambu-Goldstone pole associated with this spontaneous breaking, provided that the color confinement phase is a disordered phase where all internal symmetries remain unbroken. In the Lorenz gauge, indeed, it was shown by Hata that the restoration condition is identical to the Kugo-Ojima color confinement criterion, if the gauge transformation function $\omega(x)$ for the residual gauge symmetry is taken to be linear in x . However, this result was obtained without regard to topological configurations.

In this talk, we reconsider this issue by taking into account topological defects that are expected to play the dominant role for realizing confinement in the non-perturbative way. For concreteness, we apply this idea to obtain the restoration conditions in the Maximal Abelian and axial-like gauges and show how they are satisfied to obtain the universal picture for confinement irrespectively of gauge choice.

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Session Classification: Vacuum Structure and Confinement

Track Classification: A: Vacuum Structure and Confinement