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Confinement/deconfinement phase transition for quarks in the higher representation in view of dual superconductivity

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Dual superconductor picture is one of the most promising scenarios for quark confinement. We have proposed a new formulation of Yang-Mills theory on the lattice so that the so-called restricted field obtained from the gauge-covariant decomposition plays the dominant role in quark confinement. This framework improves the Abelian projection in the gauge-independent manner. For quarks in the fundamental representation, we have demonstrated some numerical evidences for the dual superconductivity. However, it is known that the expected behavior of the Wilson loop in higher representations cannot be reproduced if the restricted part of the Wilson loop is extracted by adopting the Abelian projection or the field decomposition naively in the same way as in the fundamental representation. Recentry, by virtue of the non-Abelian Stokes theorem for the Wilson loop operator, we have proposed suitable operators constructed from the restricted field only in the fundamental representation to reproduce the correct behavior of the original Wilson loop in higher representations. We have further demonstrated by the numerical simulation that the proposed operators well reproduce the expected behavior of the original Wilson loop average, which overcomes the problem that occurs in naively applying Abelian-projection to the Wilson loop operator for higher representations. In this talk, we focus on the the confinement and deconfinement phase transition for quarks in the higher representations at finite temperature in view of the dual superconductivity. By using our new formulation of lattice Yang-Mills theory and numerical simulations on the lattice, we extract the dominant mode for confinement by decomposing the Yang-Mills field, and we investigate the Polyakov loop average, static quark potential for both Yang-Mills field and decomposed restricted field in both confinement and deconfinement phase at finite temperature.

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