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New gauge-independent transition separating confinement-Higgs phase in the lattice gauge-fundamental scalar model

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The lattice gauge-scalar model with the scalar field in the fundamental representation of the gauge group has a single confinement-Higgs phase which is well-known as the Fradkin-Shenker-Osterwalder-Seiler analytic continuity theorem: Confinement and Higgs regions are subregions of an analytically continued single phase and there are no thermodynamics phase transitions between them.
In this talk, however, we show that we can define new type of operators which enable to separate completely the confinement phase and the Higgs phase. In fact, they are constructed in the gauge-invariant procedure by combining the original scalar field and the so-called color-direction field which is obtained by change of field variables based on the gauge-covariant decomposition of the gauge field due to Cho-Duan-Ge-Shabanov and Faddeev-Niemi.
We perform the numerical simulations for the model with SU(2) gauge group without any gauge fixing and found a new transition line which agrees with the conventional thermodynamical transition line in the weak gauge coupling and divides the confinement-Higgs phase into two separate phases, confinement and the Higgs, in the strong gauge coupling. All results are obtained in the gauge-independent way, since no gauge fixing has been imposed in the numerical simulations.
Moreover, we give a physical interpretation for the new transition from the viewpoint of the spontaneous breaking of a global (custodial) symmetry.

Topical area

Vacuum Structure and Confinement

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