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Confinement and chiral phase transitions from correlated ensemble of instanton-dyons

Confinement and chiral phase transitions are remarkable nonperturbative phenomena emerging from QCD and QCD-like theories. A theoretical understanding of these transitions and their interrelations is of fundamental importance. While it is widely perceived that their dynamics arises from nontrivial topological configurations in Yang-Mills theories, a concrete and sophisticated realization of such idea is an outstanding challenge. We report significant progress along this direction by the construction of a new framework based on correlated ensemble of instanton-dyons, namely the constituents of the finite-temperature instantons with non-trivial holonomy. We present a comprehensive numerical study of confinement properties in SU(2) Yang-Mills theory at finite temperature, obtaining important observables such as the effective holonomy potential, the static-quark potentials from Polyakov loop correlators as well as spatial Wilson loops, among others. These results are compared with lattice data. Furthermore, with the inclusion of dynamical quarks in the system, we study the nontrivial interplay between confinement/deconfinement and chiral symmetry breaking/restoration phase transitions and make predictions for how such transitions are influenced by the fermion flavor number N_f in the ensemble.

Preferred Track

New Theoretical Developments

Collaboration

Not applicable

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