Tensor network formulation of the three-dimensional SU(2) principal chiral model

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Tensor network and quantum computing are providing novel numerical approaches for lattice gauge theories in high-energy physics. These methods allow us to investigate the models suffering from the sign problem and many attempts have been made recently toward their applications to the QCD at finite density. For these future applications, it is necessary to establish how to deal with non-Abelian fields with a certain discretization scheme.

In this study, we consider the character expansion as a regularization scheme for SU(2) fields based on the path integral formalism. As a benchmark, we formulate the SU(2) principal chiral model on a cubic lattice as a tensor network and evaluate its internal energy and magnetization by the tensor renormalization group methods. Comparing them with those obtained by the Monte Carlo, we discuss the truncation effect from the character expansion and the possible extension for other lattice models.

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