High Energy Physics - Theory

A Nonperturbative Proposal for Nonabelian Tensor Gauge Theory and Dynamical Quantum Yang-Baxter Maps

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We propose a nonperturbative approach to nonabelian two-form gauge theory. We formulate the theory on a lattice in terms of plaquette as fundamental dynamical variable, and assign U(N) Chan-Paton colors at each boundary link. We show that, on hypercubic lattices, such colored plaquette variables constitute Yang-Baxter maps, where holonomy is characterized by certain dynamical deformation of quantum Yang-Baxter equations. Consistent dimensional reduction to Wilson's lattice gauge theory singles out unique compactness condition. We study a class of theories where the compactness condition is solved by Lax pair ansatz. We find that, in naive classical continuum limit, these theories recover Lorentz invariance but have degrees of freedom that scales as N^2 at large N. This implies that nontrivial quantum continuum limit must be sought for. We demonstrate that, after dimensional reduction, these theories are reduced to Wilson's lattice gauge theory. We also show that Wilson surfaces are well-defined physical observables without ordering ambiguity. Utilizing lattice strong coupling expansion, we compute partition function and correlation functions of the Wilson surfaces. We discover that, at large N limit, the character expansion coefficients exhibit large-order behavior growing faster than exponential, in striking contrast to Wilson's lattice gauge theory. This hints a hidden, weakly coupled theory dual to the proposed tensor gauge theory. We finally discuss relevance of our study to topological quantum order in strongly correlated systems.

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