Phase structure of the large-N reduced gauge theory and generalized Weingarten model

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We studied a generalization of Weingarten model reduced to a point [1], whose action is given by

\[ S = -\beta N \sum_{\mu \neq \nu}^d \text{Tr} \left( A_\mu^\dagger A_\mu A_\nu A_\nu \right) + \kappa N \sum_{\mu = 1}^d \text{Tr} \left( A_\mu^\dagger A_\mu - 1 \right)^2. \]

This model interpolates the Weingarten’s lattice string theory [2] (\(\kappa \to 0\)) and the large-\(N\) reduced \(U(N)\) gauge theory [3] (\(\kappa \to \infty\)).

We found that the \(U(1)^d\) symmetry is broken one by one, and restored simultaneously as \(U(1)^d \to U(1)^{d-1} \to \cdots \to U(1) \to 1 \to U(1)^d\) as we change the coupling constants. We also found the Gross-Witten type third order phase transitions.

In order to determine whether the continuum limit exists, we calculated the expectation value of the Wilson loop by Monte-Carlo simulation. We found that for \(d = 2\) the string tension becomes zero at the phase transition where \(U(1)^2\) symmetry breaks down. Therefore, we may take a continuum limit at this point. In order for smooth surface to dominate the path-integral, the string susceptibility must be smaller than \(-2\). Whether this is the case or not is now under investigation.

This poster session was based on the paper [1] and a work in progress with F. Kubo.

References


\(^1\)Similar model on lattice was proposed in [4].