Title:	NON- PERTURBATIVE STUDIES OF NON- CONFORMAL FIELD THEORIES
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Abstract:	Many of the exciting features of the Standard Model of the elementary particles are inherently non-perturbative. A theoretical understanding of many physics aspects beyond the Standard Model of elementary particles also requires a non-perturbative framework. One such frame- work involves discretizing quantum field theories on a spacetime lattice. We can use this lattice regularization method to study supersymmetric versions of physics beyond the Stan- dard Model. This method can also investigate the non-perturbative physics of quantum field theories that are holographically dual to theories containing gravity. In this thesis, we discuss the spacetime lattice setup, and with the examples of different models, we will see the numerical capability of this tool in exploring field theory regimes that are not accessible through perturbation theory. We use an efficient version of the Monte Carlo algorithm to update the field configurations in the path integral and eventually reach the equilibrium configurations. The thesis reports the investigation of the possibilities of non- perturbative supersymmetry breaking in quantum mechanics models with different superpo- tentials to test the algorithms and numerical setup. The gauge/gravity duality conjecture states that certain classes of field theories that do not contain gravity are equivalent to specific types of quantum gravitational theories. A ver- sion of the conjecture connects weakly coupled gravitational theories to strongly coupled field theories. Though there has been excellent progress in understanding and verifying the gauge/gravity duality conjecture by studying the maximally supersymmetric Yang-Mills the- ories in four spacetime dimensions, we will mainly focus on the non-conformal analogs of the conjecture in lower dimensions. This thesis mainly discusses the numerical simulation results of two lower-dimensional models. One is the bosonic version of the BMN (Berenstein, Maldacena, and Nastase) matrix quantum mechanics and the other is a two-dimensional Yang-Mills theory containing four supersymmetries. We focus on the transition between different phases of the theories as the deconfinement phase transitions are dual to quantum black hole solutions. The bosonic BMN matrix model is obtained by removing the fermionic degrees of freedom from the full BMN matrix model. Though the bosonic model does not admit a holographic dual, we find that it still undergoes a deconfinement phase transition. Our numerical results 2suggest that the phase diagram smoothly interpolates between the bosonic BFSS (Banks, Fis- chler, Susskind, and Shenker) and the gauged Gaussian model, with first-order deconfinement phase transition at all couplings. After this, we will focus on the thermal phase structure of a two-dimensional Yang-Mills theory that contains four supersymmetries. Our simulation re- sults show that this model admits a deconfinement phase transition in the limit of a large number of colors. We also show that the nature of the transition looks similar to its maximally supersymmetric cousin in the weak coupling regime. The thesis is concluded with a discussion of the models investigated and their numerical results, along with possible future directions
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