Stony Brook University
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Doctoral Defense Announcement
Abstract

Aspects of Superconformal Field Theories

By

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Quantum field theories are rich with beautiful structures so deep that they not only describe the physics of elementary particles but also the topology and geometry of space. Conversely, these mathematical structures offer powerful techniques to study physical problems. In my thesis, I attempt to explore this interplay and exploit it towards understanding certain properties of strongly coupled field theories. In that case, the standard Feynamn diagram techniques are seldom applicable but string theory often comes to rescue. Using the web of dualities of string theory we can answer many questions about strongly coupled quantum field theories.

AdS/CFT correspondence is a prime example of such duality. Difficult questions in strongly coupled gauge theory in large N limit are answered by simple computations in classical supergravity, making one hopeful of understanding the physics of QCD in the same way. We study the unquenched flavor in the simplest QCD, SU(N) N=2 Super Yang-Mills with 2N flavors. We found that the dual theory is a noncritical string theory whose low energy limit is a certain 7d supergravity. We also studies the one loop anomalous dimension operator in this gauge theory as a nearest neighbor Hamiltonian of certain spin chains.

String theory has also given us insights into strong/weak coupling duality of gauge theories. The S duality describes strongly interacting electric degrees of freedom in terms of weakly coupled magnetic ones. Recently a large class of N=2 supersymmetric gauge theories was conjectured to be S dual to each other. We provided a check of this conjecture by computing their Witten index, a quantity that is independent of the coupling. In the process, we discovered an alternative way of computing the index as the correlators in two dimensional Yang-Mills theory. This enabled us to compute the indices of certain supersymmetric field theories that do not admit a weakly coupled description at all.

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