

**Stony Brook University
The Graduate School**

Doctoral Defense Announcement

Abstract

Topics in String Theory and Quantum Field Theory

By

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In this work we study several topics in string theory, focusing in particular on the interplay between string theory and quantum field theory.

One of the major developments in the field in the last decade was the discovery of the AdS/CFT correspondence. In its original and most studied formulation, this is a conjectured duality relating type IIB string theory on the space $AdS_5 \times S^5$ to a four dimensional Super Yang-Mills Theory with $N=4$ supersymmetries. In this context, it was recently proposed that Wilson loops in higher representations of the gauge group have a dual description in terms of D-branes in $AdS_5 \times S^5$. In this dissertation we provide some detailed checks of this proposal, in particular by computing correlation functions between higher rank Wilson loops and chiral primary operators of the $N=4$ Super Yang Mills Theory. This computation can be carried out both in the string theory using D-branes and in the gauge theory from a matrix model, with precise agreement between the two sides. Moreover, we obtain new D-brane solutions dual to Wilson loop operators preserving one quarter of the supercharges and again find agreement between matrix model and string theory calculations of the Wilson loop expectation value. Finally, we construct a new family of supersymmetric Wilson loop operators which correspond to arbitrary curves on a three-sphere and have non-trivial expectation value. We present the general construction as well as discussing some specific example.

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