Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Studies on gauge/gravity dualities

By

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One of the most fascinating aspects of string theory is the idea of holography: the idea that some physical theory defined on a given space may be effectively described in terms of a dual theory living on the boundary of that space, in the same way as a three dimensional object can be depicted as a hologram on a two dimensional surface.

The most important example of this duality, and one of the major breakthroughs in string theory in the last ten years, is the "AdS/CFT correspondence" discovered by J. Maldacena in 1997. In this correspondence the space has ten dimensions and the theory defined in the interior, or bulk, of this space contains closed strings sweeping tubular shapes as they move, whereas the theory defined on the boundary, the four dimensional world we live in, is a highly symmetric theory describing various interacting particles. The utility of this correspondence is that one can often use one description rather than the other for computing interesting physical quantities. In fact, the two descriptions, the "boundary (or gauge) description" and the "bulk (or gravity) description", are complementary to each other, so that objects difficult to study in one picture are often easy to study in the dual picture, and vice-versa. Unfortunately, this fact makes the conjecture very hard to prove (or to disprove) because reliable computational techniques on the two sides of the duality do not have overlapping domains of validity.

In this thesis I describe several aspects of "supersymmetric Wilson loops", physical quantities that are powerful tests of the correspondence, since they can interpolate between these two opposite regimes of validity. More specifically I focus on a novel description of these loops in terms of electrically charged D-branes, and on a new class of loop operators with reduced supersymmetry.

Date: May 1, 2007
Time: 11 am
Place: Math Tower, Room 6-125

Program: Physics
Dissertation Advisor: Prof. Martin Rocek