Significant work and research plans of Michael Gutperle

Significant Scientific Work

My research interests in the past eight years have been concentrated in string theory. String theory is a leading candidate for a unified quantum theory of all interactions, including gravity. In the past I have worked alone and with many collaborators. In the following I list the works which I regard as my most significant achievements. The citation numbers refer to my publication list.

• The discovery of Dirichlet branes constituted a major breakthrough in the understanding of the nonperturbative structure of string theory. In [36] I developed a description of Dirichlet branes using boundary states in the lightcone gauge.

• In [33] I investigated nonperturbative effects in string theory coming from D-instantons and used string dualities to calculate instanton induced interaction in low energy effective actions. These terms have application in the connecting D-instantons to Yang-Mills instantons in the AdS/CFT correspondence and in the calculation of indices in certain supersymmetric quantum mechanical systems [27,29].

• In [23,26] I developed a boundary state description of Dirichlet branes in certain string compactifications called Gepner models which are constructed using supersymmetric minimal models.

• In [13,15] I investigated string backgrounds called fluxbranes. Such backgrounds are nonsupersymmetric and are useful for the study of duality relations among nonsupersymmetric string theories.

• In [6,10,11] I studied the condensation of closed string tachyon in fluxbrane and twisted circle backgrounds.

• In [10], I introduced a new object called 'S-brane' into string theory. 'S-brane' stands for spacelike brane and describes the creation and subsequent decay of an unstable brane. This idea has been fruitful in the study of time dependent dynamics in string theory. A concrete realization of this idea is found in the rolling tachyon boundary conformal field theory of A. Sen, which was analyzed further in [5].

Immediate Research Plans

In the immediate future I plan to continue my research in string theory and M-theory. My research will focus on two areas: first, supersymmetry breaking in string theory and nonsupersymmtric string theories. Second, I plan to study time dependent dynamics in string theory.

Both areas have important implications for connecting string theory to particle phenomenology beyond the standard model and cosmology. I believe that progress in these two areas will be strongly linked. In cosmology the most important questions are how inflation can be incorporated into string theory and whether string theory can explain the nature dark energy which seems to dominate the energy density of the universe today.

The conceptual framework of first quantized perturbative string theory is not well suited analyzing time dependent processes. I intend to develop new approaches using, for example, low dimensional string theories and their dual description as matrix models as a starting point.