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Abstract

Non-perturbative Studies in Supersymmetric Field Theories via String Theory

By

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The strongly coupled regime of gauge theories is of great interest in high energy physics, with quantum chromodynamics at low energies being the prime example. Non-perturbative effects become important in this regime and it is necessary to understand their contribution to the observables of interest. Supersymmetry goes a long way in constraining the structure of these effects and makes their calculation tractable. In the past few decades, phenomenal progress has been achieved in this direction by exploiting the many rigid symmetries (spacetime and internal) that are usually present in a supersymmetric field theory. Novel infinite dimensional symmetries that act on field space have also been uncovered and summarised in the very general program of the BPS/CFT correspondence. These novel symmetries offer a deeper explanation for the highly constrained nature of non-perturbative effects in supersymmetric field theories.

Superstring theory has provided us with new and powerful ways of interpreting field theoretic non-perturbative objects such as instantons, monopoles and so on. Supersymmetric field theories and their non-perturbative effects can be realised in string theory by studying the low-energy dynamics of collections of Dirichlet branes. In this thesis, we study bound states of Dirichlet branes of various dimensionalities. In particular, we explore the BPS/CFT correspondence using string theoretic tools. The underlying theme of the thesis is the rich interplay between physics in diverse dimensions and how superstring theory addresses them all in one go.

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