Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Exploring the Space of Superconformal Field Theories

By

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This dissertation focuses on the study of superconformal field theories (SCFTs) through the so-called (super)conformal bootstrap program.

The goals of this program are twofold: to chart the space of allowed SCFTs and to solve specific theories. The hope is that symmetries and a few simple physical assumptions, combined with basic consistency requirements (crossing symmetry and unitarity) are powerful enough to completely “solve” these theories. In doing so we never have to provide a Lagrangian description for the theories in question, and thus we can employ the bootstrap in studying SCFTs for which no such description is known. This is the case of many of the theories considered in this dissertation, making the bootstrap an ideal tool to explore them.

Most of this dissertation focuses on SCFTs in four-dimensions with $\mathcal{N} = 2$ supersymmetry. The large amount of symmetry of these theories makes them more tractable, and we find that the crossing symmetry equations admit a solvable subsector. This gives rise to the identification of a two-dimensional chiral algebra inside the four-dimensional SCFT, which allows for exact results to be obtained, including new unitarity bounds, constraining the space of allowed SCFTs.

However, if we want to study the full theory, we must analyze the full set of crossing equations by resorting to numerical techniques. In this work we begin such an analysis, obtaining various bounds on central charges and operator dimensions which are valid for any SCFT.

In the last part of this dissertation we extend the numerical bootstrap analysis for SCFTs in six-dimensions with $\mathcal{N}= (2,0)$ supersymmetry.

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