Stony Brook University
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Abstract

Applications of 2D CFT : Entanglement Negativity and Soft Theorem

By

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Conformal field theory, especially two dimensional conformal field theory has been an active and fruitful topic of theoretical physics for decades. As an powerful tool and insightful approximation, it has been widely used in different field of physics such as string theory, statistic physics and condensed matter physics. In this dissertation I shall discuss two different subjects in which the results of 2D CFT can be applied: entanglement negativity and soft gluon/gravity theorem.

2D CFT is one of the most important approach in calculating entanglement of 1D free system. By applying replica trick, entanglement entropy can be expressed as the path integral of the free field on a Riemann surface, or equivalently correlation function of corresponding twist operators. The same approach applies to negativity, a well defined measure for mixed states. In this dissertation we discussed the negativity of free fermions, which is a hard problem because of the summation over boundary conditions and the non-rational terms in the summation. And I shall present in detail how some of the terms can be reduced to rational functions by Thomae's formula and how to use these terms to construct upper and lower bounds of free fermion negativity.

In the second part of the dissertation I shall discuss the soft gluon/graviton theorem of scattering amplitudes. The connection between 4D scattering amplitudes and 2D CFT is discussed a lot in recent years. They share the same symmetry SL(2, C) . By replacing the plane wave external legs by the SL(2, C) wave packet, one can transform from scattering amplitudes to Witten diagrams in AdS3 , which then map to correlation functions on the boundary.Especially the soft gluon and graviton theorems can be map to ward identity of the BMS symmetry. In this dissertation I shall show how these two soft theorems are related through KLT relations.

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