Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Explorations in Planar N=4 super Yang-Mills

By

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Maximally supersymmetric Yang-Mills (MSYM) has proven a rich laboratory for the study of gauge theory amplitudes, especially in the planar limit. Planar MSYM is expected to have a finite radius of convergence, a radius which is approached relatively rapidly in the cusp anomalous dimension, a quantity known for all values of the coupling. This suggests that, were the full analytic form of the amplitude accessible at moderate loop orders, it might be possible to observe the radius of convergence in the ratios of successive loop orders. However, while there are many recent advances in the computation of the integrands of MSYM amplitudes, going from the integrand to the amplitude remains challenging.

In this dissertation, I pursue another tack. The space of functions that can appear in finite quantities in planar MSYM is quite limited, owing to the theory's property of maximal transcendentality. My collaborators and I construct a space of functions appropriate to all six-point processes in planar MSYM, using a coproduct in the space of multiple polylogarithms to bootstrap these "Hexagon Functions" up in transcendental weight. By constructing an ansatz of these functions and constraining it using predicted Multi-Regge and near-collinear behavior, we find analytic forms for the six-point MHV remainder function and NMHV ratio function at three loops in planar MSYM, without any need to compute Feynman integrals. Remarkably, the theory's finite radius of convergence leaves hints even at this low loop order, as the ratio between the three-loop and two-loop remainder functions is approximately -7 throughout the appropriate parameter space.

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