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Amplitudes, Ansätze and Algebraic Geometry

Wednesday, February 15, 2023 11:30 AM (30 minutes)

Multi-particle scattering amplitudes beyond tree level are complicated functions of many variables. In practical computations, amplitudes are organized as a linear combination of transcendental functions with rational functions as coefficients. The computation of these rational functions in cutting-edge cases poses a significant challenge. In the modern approach, these rational functions are computed by using numerical evaluations to constrain an Ansatz. An important problem is thus to construct Ansätze for the rational functions that contain very few free parameters.

In this talk, we discuss an approach to constructing compact Ansätze for rational functions in amplitudes by making use of their non-trivial behavior in singular limits. This behavior imposes powerful constraints on the analytic structure of the rational functions, which we then use to construct compact partial fractions Ansätze. Understanding and implementing these constraints is a non-trivial problem that we solve using tools from (computational) algebraic geometry. Specifically, we interpret the constraints as statements of membership of the numerator of the rational function to certain "ideals" of polynomials, as prescribed by the "Zariski-Nagata" theorem. We will discuss the computational bottlenecks which arise in this framework, as well as potential directions for breaking them.

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