Contribution ID: **85** Type: **not specified**

Scattering-amplitude ansätze from algebraic geometry and p-adic numbers

Wednesday 27 April 2022 09:00 (30 minutes)

Scattering amplitudes in perturbative quantum field theory exhibit a rich structure of zeros, poles, and branch cuts, which are best understood as varieties in complexified momentum space. It is also well known that scattering amplitudes in gauge theories admit compact representations in the spinor-helicity formalism. However, obtaining such compact representations is often a non-trivial task due to the many variables subject to constraints, such as momentum conservation and Schouten identities. We build compact spinor-helicity ansätze for the rational coefficients of scattering amplitudes by making manifest their behavior on varieties where they may diverge, which we dub "singular varieties". Algebraic geometry provides a natural language to describe such geometric varieties in terms of algebraic *ideals*. For the first time, we systematically identify irreducible singular varieties via primary decompositions of the respective ideals in spinor space, and we introduce a tool from number theory, namely p-adic numbers, to evaluate the rational coefficients in proximity to these singular varieties in a stable and efficient manner. In some sense, p-adic numbers bridge the gap between finite fields and floating-point numbers by combining the stability of finite fields with a non-trivial absolute value. By the Zariski-Nagata theorem, numerical evaluations of the rational coefficients close to varieties of codimension two lead to constraints on the numerators in terms of membership to a particular type of ideals, the symbolic power. Finally, as a proof-of-concept application, we use these constraints to build compact ansätze for the pentagon-function coefficients of the two-loop $0 \to q\bar{q}\gamma\gamma\gamma$ helicity amplitudes.

Primary author: DE LAURENTIS, Giuseppe (Freiburg University)

Co-author: PAGE, Ben (Freiburg University)

Presenter: DE LAURENTIS, Giuseppe (Freiburg University)

Session Classification: Parallel 4