Contribution ID: **15** Type: **not specified**

Towards two-loop automation in OpenLoops

Friday 29 April 2022 17:30 (30 minutes)

Towards two-loop automation in OpenLoops

Numerical tools, such as OpenLoops, provide NLO scattering amplitudes for a very wide range of hard scattering amplitudes in a fully automated way. In order to match the numerical precision of current and future experiments, however, the higher precision of NNLO calculations is essential, and their automation in a similar tool highly desirable.

In our approach, D-dimensional two-loop amplitudes are decomposed into Feynman integrals with four-dimensional numerators as well as (D-4)-dimensional remainders, which can contribute to the finite result through the interaction with the poles of Feynman integrals.
The integrals with four-dimensional numerators are then expressed as tensor integrals in the loop momenta contracted with tensor coefficients. The necessary building blocks for a full calculation in this framework are hence the treatment of (D-4)-dimensional numerator parts, the numerical construction of the tensor integral coefficients, the tensor integral reduction and the evaluation of the master integrals.

As the first important step in this approach, we present a method to reconstruct the contributions stemming from the interplay of (D-4)-dimensional numerator parts and UV poles through universal rational counterterms, as well as the computation of the full set of rational terms of UV origin for QCD and QED corrections to the SM.

The second building block we present in this talk, is a new and completely generic algorithm for the efficient and numerically stable construction of the tensor coefficients to the four-dimensional two-loop Feynman integrals. This algorithm is fully implemented in the OpenLoops framework.

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Session Classification: Parallel 9