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Novel methods for calculating Feynman integrals and applications to QCD processes

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Feynman integrals are crucial for obtaining physical predictions from perturbative quantum field theory. Recent years have seen tremendous advances both in our understanding of Feynman integrals, and in our ability of computing them. In particular, novel ideas linking properties of loop integrands to the differential equation method have lead to an unprecedented degree of automation of calculations. As a result, the canonical differential equation method is now an indispensable tool for collider physics. Objectives that previously appeared prohibitive, such as full next-to-next-to-leading order corrections for QCD processes involving many particles, are now within reach. This removes an important bottleneck for a broad range of physics applications. In this talk, after reviewing the latest conceptual developments for Feynman integrals, I will present cutting-edge physics results obtained with the new methods, such as the complete result for the four-loop cusp anomalous dimension, as well as the three- and two-loop non-planar Feynman integrals needed for two- and three-jet production, respectively.

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Author: HENN, Johannes

Presenter: HENN, Johannes

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