Invitation à la soutenance publique de thèse de
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Master of Science ETH in Physik

Pour l’obtention du grade de Docteur en sciences

« Novel paths from special functions to scattering amplitudes »

qui se déroulera
le vendredi 23 août 2019 à 16h
Auditoire LAVO 51
Place Louis Pasteur, 1
1348 Louvain-la-Neuve

Jury members :
Prof. Claude Duhr (UCLouvain), supervisor
Prof. Jan Govaerts (UCLouvain), chairperson
Prof. Marino Gran (UCLouvain), secretary
Prof. Fabio Maltoni (UCLouvain)
Prof. Vittorio Del Duca (ETH Zürich, Switzerland)
Prof. Olivier Schlotterer (Uppsala Univ., Sweden)

In this thesis we are investigating the mathematical dependence of scattering amplitudes on kinematical invariants. In particular, we are analyzing the underlying geometries of scattering amplitudes in order to predict the resulting function space. We then use this knowledge of the function space to find suitable, more efficient ways to perform the computation of scattering amplitudes.

First, we consider the forward-scattering limit of amplitudes in \( N=4 \) supersymmetric Yang-Mills theory (SYM), where scattering amplitudes can be written as linear combinations of building blocks that can be expressed in terms of single-valued multiple polylogarithms. Further, we introduce a novel mathematical formalism for the computation of these building blocks exploiting their single-valuedness that allows us to compute scattering amplitudes very efficiently. Finally, we find relations among building blocks for different numbers of external particles, generalizing the factorization of scattering amplitudes observed at two loops. This allows us to compute scattering amplitudes for any number of external particles. Lastly, we show that the formalism introduced for computations in \( N=4 \) SYM can be used for the computation of scattering amplitudes in other theories like quantum chromo dynamics.

As a second part we consider a family of three-loop Feynman integrals called the banana integral family. We show that the equal-mass case of the banana family can be related to the elliptic curve underlying the well-studied sunrise integral family. We relate the solutions for the banana integral family to the functions defined on the elliptic curve of the sunrise integral and subsequently solve the banana integral family in terms of these functions.