T 46: Theorie: QCD

Zeit: Dienstag 16:00–18:30 Raum: ST 8

T 46.1 Di 16:00 ST 8

Resonance-Aware Subtraction in the Dipole Methode — •Sebastian Liebschner[1], Frank Siegert[1], and Stefan Höche[2] — [1]Institut für Kern- und Teilchenphysik, TU Dresden, 01069 Dresden, Germany — [2]SLAC National Accelerator Laboratory, Menlo Park, CA, 94025, USA

NLO-subtraction schemes such as CS-dipole-subtraction are indispensable for MC-Generators to calculate real and virtual corrections efficiently. However, those algorithms suffer from numerical inefficiencies and even cause distortions in physical distributions when interfaced with parton showers, if the process in question comprises potentially resonant particles. In this talk I will elucidate this matter and offer an alternative subtraction-scheme, which makes use of so called pseudo-dipoles. I will show results, which have been calculated with a SHERPA-implementation of this new pseudo-dipole-subtraction and compare them to the ones obtained with ordinary CS-dipole-subtraction.

T 46.2 Di 16:15 ST 8

The Complete $O(\alpha_s^2)$ Pure-Singlet Heavy Flavour Corrections to the Unpolarized and Polarized Deep-Inelastic Structure Functions — Johannes Blümlein[1], Abilio De Freitas[1], Clemens Raab[2], and •Kay Schönwald[1] — [1]DESY, Zeuthen — [2]Johannes Kepler Universität, Linz

We calculate analytically the flavour pure-singlet $O(\alpha_s^2)$ massive Wilson coefficients for the inclusive structure functions F_2, F_L and g_1 at general virtualities Q^2 in the deep-inelastic region. We discuss their functional representation, illustrate their large-scale factorization and threshold-representation, and present numerical results.

T 46.3 Di 16:30 ST 8

Integrating double-unresolved collinear emissions for NNLO computations — •Maximilian Delto and Kirill Melnikov — Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology (KIT)

We will describe an analytic computation of integrals of triple-collinear splitting functions that emerge as counter-terms in the context of the nested soft-collinear subtraction scheme. Analytic results for counterterms are important for demonstrating analytic cancellation of infrared and collinear divergences in fully-differential NNLO description of generic hard scattering processes in hadron collisions.

T 46.4 Di 16:45 ST 8

Dimensional Recurrence and Analyticity in C++ — •Mario Prausa — Albert-Ludwigs-Universität, Freiburg, Germany

Dimensional Recurrence and Analyticity (DRA) is a powerful tool to calculate single-scale multi-loop Feynman integrals to very high precision. Using Tarasov's dimensional shifts and integration-by-parts identities it is straightforward to derive Dimensional Recurrence Relations (DRRs) for a set of master Feynman integrals. The DRRs relate Feynman integrals in d space-time dimensions to the same Feynman integrals in $d+2$ dimensions. In the DRA method these relations are solved using input from the pole structure of the Feynman integrals.

DRA is exceptionally well-suited to be implemented in an object-oriented framework. In this talk I will present an upcoming fully automated `C++` implementation and demonstrate its usability with a nontrivial example.

T 46.5 Di 17:00 ST 8

The gradient flow at higher orders in perturbation theory — Johannes Artz[1], Robert V. Harlander[1], Yannick Kluth[2], •Fabian Lange[1], Tobias Neumann[3,4], and Mario Prausa[5] — [1]RWTH Aachen University, Aachen, Germany — [2]University of Sussex, Brighton, UK — [3]Illinois Institute of Technology, Chicago, USA — [4]Fermilab, Batavia, USA — [5]Albert-Ludwigs-Universität, Freiburg, Germany

The gradient or Wilson flow has proven to be a useful tool in lattice QCD calculations in the last years. It also offers promising possibilities of cross-fertilization of lattice and perturbative calculations. Up to now, perturbative calculations in the gradient-flow formalism have mostly been carried out to next-to-leading order. Experience shows that the step to next-to-next-to-leading order (NNLO) typically leads to a significant improvement of the perturbative accuracy.

We apply well-known techniques for multi-loop calculations to the gradient-flow formalism in order to systematically compute higher orders. After describing our general setup, we show NNLO results of central observables like the gluon action density, which may offer a possibility to extract α_s from lattice results. We also present a lattice formulation of the energy-momentum tensor in the gradient-flow formalism through NNLO.

T 46.6 Di 17:15 ST 8

Laporta algorithm with finite fields — •Jonas Klappert and Fabian Lange — RWTH Aachen University

The implementation of rational functions from their numerical values over a field has been actively studied in computer science and mathematics over the last few decades. Recently, its application to calculations in High Energy Physics has become of interest since in a purely numerical framework no large intermediate expressions occur. The latter often lead, due to a limitation of hardware, to the failure of purely analytic calculations. In this talk, we present efficient algorithms to solve these interpolation problems and their implementation in the publicly available `C++` library `FireFly`. To demonstrate their capability, we apply them to the reduction of multi-scale Feynman integrals with the Laporta algorithm.

T 46.7 Di 17:30 ST 8

Automatizing the calculation of the N-jettiness soft function — •Tobias Mohrmann — Universität Siegen

Whenever a QCD-scattering process is restricted to its soft region, soft functions emerge. They are essential ingrediants of factorization theorems within Soft-Collinear Effective Theory (SCET). In this talk I present a systematic framework for the calculation of soft functions which are defined in terms of $N \geq 2$ light-like Wilson lines for generic observables. For this purpose we introduce a phase space parametrization which allows the factorization of universal singularities for soft functions. The formalism is an extension of a method that some of my collaborators developed earlier for the calculation of dijet soft functions. We have implemented this framework using the public code "pySecDec" to compute 1-jettiness and 2-jettiness soft function numerically.

T 46.8 Di 17:45 ST 8

Recursion Relations for Massive Scattering Amplitudes — •Robert Franken — Julius-Maximilians-Universität, Würzburg

In this talk I will show that scattering amplitudes with massive or massless particles of spin $s \leq 1$ in renormalisable theories can be constructed recursively out of amplitudes with a lesser number of external legs. The basic idea is to deform the momenta of the external particles by shifting them into the complex plane in such a manner that on-shellness and overall momentum conservation are preserved. The precise shifting procedure depends on the kind of the involved particles and their spin projected along a reference axis.

Using Cauchy's residue theorem leads to connect the physical amplitude to emerging poles in the complex plane and a contour integral which is forced to vanish by deforming enough external momenta.

It turns out that shifting 5 external legs is always sufficient, shifting 3 external legs is sufficient except all external particles are scalars or longitudinally polarised vector bosons.

Furthermore the introduction of special reference frames to guarantee a good behaviour of the contour integral and hence recursive constructibility involves some subtleties. Especially the reference frames for individual particles are different. To overcome these problems a formalism to convert a posteriori between different reference frames is introduced, leading to a description in a common frame.

Together with construction rules, that forbid certain helicity combinations in the 3-point amplitudes, a set of selection and suppression rules can be derived.

T 46.9 Di 18:00 ST 8

Parton-shower effects in electroweak W^+Zjj production at the next-to-leading order of QCD — Barbara Jäger[1], Alexander Karlberg[2], and •Johannes Scheller[1] — [1]Institute for Theoretical Physics, University of Tübingen, Auf der Morgenstelle 14, 72076

Tübingen, Germany — [2]Physics Institute, University of Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland

We present an implementation of W^+Zjj production via vector-boson fusion in the `POWHEG BOX`, a public tool for the matching of next-to-leading order QCD calculations with multi-purpose parton-shower generators. We provide phenomenological results for electroweak W^+Zjj production with fully leptonic decays at the LHC in realistic setups and discuss theoretical uncertainties associated with the simulation. We find that beyond the leading-order approximation the dependence on the unphysical factorization and renormalization scales is mild. The two tagging jets are furthermore very stable against parton-shower effects. However, considerable sensitivities to the shower Monte-Carlo program used are observed for central-jet veto observables.

T 46.10 Di 18:15 ST 8

Automated production and evaluation of interpolation grids for cross sections at next-to-next-to-leading order — Günter Quast, Klaus Rabbertz, and •Miguel Santos Correa — ETP, KIT Karlsruhe

The recent availability of calculations in perturbative QCD at next-to-next-to-leading order (NNLO) offers another significant increase in precision for comparisons between theory and experimental data e.g. from collisions at the LHC. To avoid repetitions of these CPU intensive computations for variations of input parameters, the interpolation grid technique as implemented in APPLgrid and fastNLO is used together with the original theory code in the form of the NNLOJET package. Up to now many manual steps are required for setup, quality checks, parallelised production on thousands of compute nodes, harvesting, and combination of subgrids to the final product.

We present as an example calculation the triple-differential Z+jet cross section, suitable for precision comparisons to LHC data, and demonstrate the implementation of an automated pipeline based on the software packages Luigi and LAW for the creation of such high precision interpolation grids at NNLO.