T 20: QCD (Theorie) 1

Zeit: Montag 11:00–12:30 Raum: P110

T 20.1 Mo 11:00 P110

On color decomposition of QCD (one-loop) amplitudes and generalized shuffle relations. — •Christian Reuschle — KIT, Institute for Theoretical Physics, Karlsruhe, Germany

In recent years, the automated calculation of NLO processes has become more and more advanced, where NLO QCD processes with a multitude of partons in the final state have been of special interest. In order to handle the rather complex color structure of multi-parton QCD amplitudes one can thereby resort to color decomposition, where QCD amplitudes are decomposed into sums over simple color strings multiplied by kinematical factors, the so called partial amplitudes. In the simplest cases all the diagrams in a partial amplitude have the same cyclic ordering of the external legs. In more involved cases (tree-level QCD amplitudes with more than two quark-pairs and any one-loop QCD amplitude) this property is lost and partial amplitudes have to be further decomposed into primitive amplitudes. In the case of one-loop QCD amplitudes with more than one quark-pair the decomposition into primitive amplitudes is highly non-trivial and closed analytic expressions in the most general case of an arbitrary number of external quark-pairs and any number of gluons, so called all-n formulae, have in fact not been known until recently. In this talk I will report on a recent advancement in this direction and present the first all-n formulae for the color decomposition of QCD one-loop amplitudes with an arbitary number of external quark-pairs into primitive amplitudes, based on generalized shuffle relations.

T 20.2 Mo 11:15 P110

QCD factorization of infrared singularities in DRED — •Christoph Gnendiger — Institut für Kern- und Teilchenphysik, TU Dresden

In this work we analyze factorization properties of infrared singularities in massless QCD at two-loop order in different forms of dimensional regularization, including Conventional Dimensional Regularization (CDR) and Dimensional Reduction (DRED).

In CDR it is known that infrared singularities can be predicted by a general and compact formula. We show that in DRED the results are not in agreement with this formula, but with a modified one. We explain the origin of this modification and show how to convert CDR-results into DRED.

T 20.3 Mo 11:30 P110

Pure-singlet heavy flavour contributions to DIS — •Arnd Behring[1], Johannes Blümlein[1], Abilio de Freitas[1], Andreas von Manteuffel[2], and Carsten Schneider[3] — [1]Deutsches Elektronen Synchrotron DESY, Zeuthen, Germany — [2]PRISMA Cluster of Excellence and Institute of Physics, J. Gutenberg University, Mainz, Germany — [3]Research Institute for Symbolic Computation (RISC), Johannes Kepler University, Linz, Austria

Heavy quark flavours yield an essential contribution to deep-inelastic structure functions. They are relevant for the extraction of PDFs from *ep* scattering data. These massive contributions factorize in the kinematic region $Q^2 \gg m^2$ into massless Wilson coefficients H_{ij}^k and massive operator matrix elements A_{ij}^k. We present recent results on the pure singlet massive operator matrix element $A_{Qq}^{\mathrm{PS},(3)}(x,\mu^2)$ and the Wilson coefficient $H_{Qq}^{\mathrm{PS}}(x,Q^2)$ at 3-loop order, give details on their calculation and present numerical predictions for experiment.

T 20.4 Mo 11:45 P110

Long range gluonic interactions between color singlets — •Nora Brambilla, Vladyslav Shtabovenko, Jaume Tarrús Castellà, and Antonio Vairo — TU München, Deutschland

Long range gluonic interactions between color singlets (CS) like heavy quarkonia involve several well separated energy scales. The physics of heavy quarkonia is successfully described by NRQCD and pNRQCD, two non-relativistic effective field theories (EFTs) of QCD that can be derived from the full QCD Lagrangian by successively integrating out the energy scales m_Q and $m_Q\alpha_s$, where m_Q is the heavy quark mass. To treat the interactions between CS in the same framework, it is natural to introduce an additional scale of momentum exchange $|\mathbf{k}|$. Depending on the relative size of $|\mathbf{k}|$, different scale hierarchies that lead to different EFTs are possible. To test the validity of this approach, we first studied the electromagnetic Van der Waals force between hydrogen atoms for two different scale hierarchies and developed corresponding EFTs of QED. This talk will give an overview of our results for the electromagnetic Van der Waals force and will discuss the first applications of our approach to the gluonic long range forces between color singlets.

T 20.5 Mo 12:00 P110

Three-loop Debye mass in thermal QCD — •Ioan Ghişoiu — Institute for Theoretical Physics , Universität Bern, Schweiz

The QCD Debye mass is computed to three-loop order as a matching parameter of the dimensionally reduced theory of EQCD. While physically it determines the screening of the color-electric fields in a quark-gluon plasma, the Debye mass also enters the pressure of hot QCD to $\mathcal{O}(g^7)$. Moreover, diving into a technically challenging problem, we also establish a new method for computing three-loop tensor sum-integrals.

T 20.6 Mo 12:15 P110

Chiral symmetry breaking, phase structure and thermodynamics of QCD with mesonic degrees of freedom — •Mario Mitter — Institut für Theoretische Physik, Universität Heidelberg

In the non-perturbative regime of Quantum Chromodynamics (QCD) mesons are important degrees of freedom. They can be introduced in a description of QCD, e.g. via the dynamical hadronization technique where mesonic operators are used to bosonize certain quark interactions. The phase structure of QCD and effects of axial U(1)-symmetry violation are investigated in a description utilizing mesonic degrees of freedom. The thermodynamics close to the chiral transition are compared to corresponding results from lattice QCD.