

Resummation, Evolution, Factorization 2021



Report of Contributions

Contribution ID: 1

Type: **not specified**

Introduction

Monday, 15 November 2021 13:40 (20 minutes)

Online

Presenter: JUNG, Hannes (CMS (CMS Fachgruppe QCD))

Contribution ID: 2

Type: **not specified**

Determination of the Collins-Soper Kernel from Lattice QCD via moments of quasi-TMDs

Tuesday, 16 November 2021 15:00 (20 minutes)

We present lattice results for the non-perturbative Collins-Soper (CS) kernel, which describes the energy-dependence of transverse momentum-dependent parton distributions (TMDs). The CS kernel is extracted from the ratios of first Mellin moments of quasi-TMDs evaluated at different nucleon momenta.

The analysis is done with dynamical $N_f = 2 + 1$ clover fermions for the CLS ensemble H101 ($a = 0.0854$ fm, $m_\pi = m_K = 422$ MeV). The computed CS kernel is in good agreement with experimental extractions and previous lattice studies.

Primary author: SCHLEMMER, Maximilian

Presenter: SCHLEMMER, Maximilian

Session Classification: TMDs

Contribution ID: 3

Type: **not specified**

Heavy-flavor production and the kt-factorization approach in a variable-flavor-number scheme

Thursday, 18 November 2021 15:40 (20 minutes)

We present our last work (2108.06419) on D and B-meson production in the kt-factorization approach. One of our goals is to emphasize the importance of using the same scheme for UPDFs and matrix elements. Our calculations, based on 2->2 processes computed in a general-mass variable-flavor-number scheme, are compared to ALICE and LHCb data. Finally, we discuss how the 2->1 process could be consistently included in our calculations and the expected consequences of this implementation.

Primary author: GUIOT, Benjamin (Universidad Tecnica Federico Santa Maria)

Presenter: GUIOT, Benjamin (Universidad Tecnica Federico Santa Maria)

Session Classification: TMDs

Contribution ID: 4

Type: **not specified**

Jet-based TMD measurements with H1 data and machine-learning unfolding

Wednesday, 17 November 2021 17:30 (20 minutes)

Recently, jet measurements in deep-inelastic scattering (DIS) events close to Born kinematics have been proposed as a new probe to study transverse-momentum-dependent (TMD) PDFs, TMD fragmentation functions, and TMD evolution. In this talk, I will report measurements of lepton-jet momentum imbalance in high- Q^2 DIS events collected with the H1 detector at HERA. These data bridge DIS measurements from fixed target experiments and Drell-Yan measurements at colliders, thus providing a stringent test of TMD factorization, evolution and universality. This measurement also represents the first example of unfolding assisted with machine learning. These results serve as a pathfinder for the Electron-Ion Collider jet-based 3D imaging program, which I will describe briefly.

Primary author: ARRATIA, Miguel (University of California, Riverside)

Presenter: ARRATIA, Miguel (University of California, Riverside)

Session Classification: ep processes

Contribution ID: 5

Type: **not specified**

The Collins-Soper kernel from lattice QCD via quasi TMDPDFs

Tuesday, 16 November 2021 14:40 (20 minutes)

I will describe recent lattice QCD determinations of the nonperturbative Collins-Soper kernel, which describes the rapidity evolution of quark transverse-momentum-dependent parton distribution functions. It is found that different approaches to extract the Collins-Soper kernel from the same underlying lattice QCD matrix elements yield significantly different results and uncertainty estimates, revealing that power corrections, such as those associated with higher-twist effects, and perturbative matching between quasi and light-cone beam functions, cannot be neglected. I will discuss the implications of these observations for future controlled calculations of this quantity, and what will be required to achieve them.

Primary authors: SHANAHAN, Phiala (MIT); WAGMAN, Michael; ZHAO, Yong

Presenter: SHANAHAN, Phiala (MIT)

Session Classification: TMDs

Contribution ID: 6

Type: **not specified**

The k_t - and (z, k_t) -factorizations and their applications to the $e-p$ and $p-p$ collisions

Thursday, 18 November 2021 14:20 (20 minutes)

In the frameworks of k_t - and (z, k_t) -factorizations we discuss various TMDs (UPDFs) such as KMR, MRW, and PB which are based on the Sudakov form factor and the different angular ordering. The comparison is also made with the TMDlib and its possible extensions. The dependence of the above TMDs on input PDFs i.e. MSHT20, MMHT2014, CT14, etc are investigated. Finally, different processes such as e.g. $p-p$ Drell-Yan and $e-p$ inclusive jets productions in the above frameworks and KATIE parton-level event generator are discussed and the comparison is also made with the available experimental data.

Primary author: Mr KORD VALESHABADI, Ramin (University of Tehran)

Co-authors: MODARRES, Majid (University of Tehran); Ms SOMAYEH , Rezaie (University of Tehran)

Presenter: Mr KORD VALESHABADI, Ramin (University of Tehran)

Session Classification: TMDs

Contribution ID: 7

Type: **not specified**

A Monte-Carlo Simulation of Double Parton Scattering

Monday, 15 November 2021 16:10 (20 minutes)

Double parton scattering (DPS) is the process in which one has two separate hard scatterings in an individual proton-proton collision. In recent years much progress has been made towards the proper description of this phenomenon in QCD, including a consistent description of perturbative splittings that yield the parton pair in one or both protons, and a coherent framework for combining both double and single scattering without double counting. However, phenomenological predictions for DPS are often made using Monte Carlo codes or the “pocket formula”, which are based on a simple picture of two uncorrelated scatters. I describe the development of a new Monte Carlo simulation for DPS, dShower, that is based on the modern theoretical picture. The structure of the DPS shower will be discussed, as well as the procedure to combine this shower with an SPS shower such that one can simulate both processes without double counting.

Primary author: GAUNT, Jonathan (University of Manchester)

Presenter: GAUNT, Jonathan (University of Manchester)

Session Classification: Multiparton interactions

Contribution ID: 8

Type: **not specified**

Track functions and TMD physics

Thursday, 18 November 2021 14:00 (20 minutes)

I will talk about track functions and TMD physics.

Primary author: WAALEWIJN, Wouter (University of Amsterdam / Nikhef)

Presenter: WAALEWIJN, Wouter (University of Amsterdam / Nikhef)

Session Classification: TMDs

Contribution ID: 9

Type: **not specified**

The role of pT resummation in fiducial cross sections at the LHC

Thursday, 18 November 2021 18:00 (20 minutes)

I discuss the importance of pT resummation in fiducial cross sections at the LHC, using gluon-fusion Higgs production in the diphoton decay channel with fiducial cuts as an example. In particular, I discuss the treatment of fiducial power corrections that make the total cross section sensitive to small-pT resummation effects, and thereby enhance the N3LO correction. Integrating the resummed pT spectrum at N3LO+N3LL' accuracy thus allows us to predict for the first time the total fiducial cross section N3LO and improved by resummation.

Primary authors: EBERT, Markus (Max-Planck-Institut für Physik); TACKMANN, Frank (T (Phenomenology)); BILLIS, Georgios (T (Phenomenology)); DEHNADI, Bahman (DESY fellow); MICHEL, Johannes (MIT)

Presenter: EBERT, Markus (Max-Planck-Institut für Physik)

Session Classification: pp processes

Contribution ID: 10

Type: **not specified**

Transverse Momentum Dependent Gluon Distribution within High Energy Factorization at Next-to-Leading Order

Wednesday, 17 November 2021 15:20 (20 minutes)

We discuss Transverse Momentum Dependent (TMD) gluon distributions within high energy factorization at next-to-leading order in the strong coupling within the framework of Lipatov's high energy effective action. Unlike previous results obtained within high energy factorization, our framework allows to recover the complete anomalous dimension associated with Collins-Soper-Sterman (CSS) evolution of the TMD distribution, including also single-logarithmic terms in the CSS evolution. Another interesting feature concerns the relation between unpolarized and linearly polarized gluon TMD in the BFKL limit. While our calculation confirms that both distributions agree in the BFKL limit at leading order, we find that they differ, once next-to-leading order corrections are being included. We furthermore establish a link between the QCD operator definition of the TMD gluon distribution and a previously derived off-shell TMD gluon-to-gluon splitting function, which is within the present framework obtained as the real 1-loop correction.

Primary author: HENTSCHINSKI, Martin (Universidad de las Americas Puebla)

Presenter: HENTSCHINSKI, Martin (Universidad de las Americas Puebla)

Session Classification: Small x

Contribution ID: 11

Type: **not specified**

Gauge-invariant TMD factorization for Drell-Yan hadronic tensor at small x

Wednesday, 17 November 2021 14:40 (20 minutes)

The Drell-Yan process is studied in the framework of TMD factorization in the Sudakov region $s \gg Q^2 \gg q_{\perp}^2$ corresponding to recent LHC experiments with Q^2 of order of mass of Z-boson and transverse momentum of DY pair \sim few tens GeV. The Drell-Yan hadronic tensors are calculated with $\frac{1}{Q^2}$ accuracy, first at the tree level and then with the double-log accuracy. It is demonstrated that in the leading order in N_c the higher-twist quark-quark-gluon TMDs reduce to leading-twist TMDs due to QCD equation of motion. The resulting tensor for unpolarized hadrons is EM gauge-invariant and depends on two leading-twist TMDs: f_1 responsible for total DY cross section, and Boer-Mulders function h_1^{\perp} . The corresponding qualitative and semi-quantitative predictions for angular coefficients of Z-boson production seem to agree with LHC data at corresponding kinematics.

Primary author: BALITSKY, Ian (JLab/ODU)

Presenter: BALITSKY, Ian (JLab/ODU)

Session Classification: Small x

Contribution ID: 12

Type: **not specified**

TMDPDFs and TMDFFs at N3LO for N3LL' Resummation

Tuesday, 16 November 2021 17:10 (20 minutes)

In this talk I discuss the calculation at N³LO of the quark and gluon unpolarized q_T Beam Functions and of the TMD Fragmentation Functions. I illustrate their role in the resummation of QCD observables at N3LL', such as q_T distributions and Energy Energy Correlators. The matching kernels onto standard PDFs or FFs of these collinear gauge invariant objects can be obtained from the collinear expansion of differential partonic cross sections at the LHC, which we have calculate at N³LO for both Drell-Yan and Higgs production in gluon fusion. I conclude by presenting the results for the N3LO EEC Jet Function and the resummation at N3LL' of the EEC in the back-to-back limit.

Primary author: Dr VITA, Gherardo (SLAC)

Presenter: Dr VITA, Gherardo (SLAC)

Session Classification: Parallel session

Contribution ID: 13

Type: **not specified**

Forward dijet production at the EIC: beyond the TMD factorization

Wednesday, 17 November 2021 17:10 (20 minutes)

Measurements of azimuthal correlations in the production of forward dijets in deep inelastic scattering provide the opportunity to probe the Weizsäcker-Williams gluon transverse momentum dependent (TMD) parton distribution, and the possibility for the discovery of gluon saturation at the future Electron-Ion Collider (EIC). While the TMD factorization is expected to hold near back-to-back production, there are important kinematic (perturbative power) and genuine saturation contributions that must be resummed for more controlled phenomenological predictions.

In this talk, I will compare the results of the TMD and the improved TMD factorization framework to those in the Color Glass Condensate (CGC), and report on the expected size of kinematic and genuine saturation corrections at different kinematics accessible at the EIC [1]. I will discuss recent progress towards the computation of dijet production at the next-to-leading order in the CGC [2], and the possibility of extending the TMD-CGC correspondence to higher orders in perturbation theory.

References:

[1] The importance of kinematic twists and genuine saturation effects in dijet production at the Electron-Ion Collider. JHEP 09 (2021) 178. [arXiv: 2106.11301 hep-ph]

R. Boussarie, F. Salazar, H. Mäntysaari, and B. Schenke.

[2] Dijet impact factor in DIS at next-to-leading order in the Color Glass Condensate. Submitted to JHEP. [arXiv: 2108.06347 hep-ph]

P. Caucal, F. Salazar, and R. Venugopalan.

Primary authors: SALAZAR, Farid (UCLA); MÄNTYSAARI, Heikki (University of Jyväskylä); BOUSSARIE, Renaud (Ecole Polytechnique, CPHT); SCHENKE, Björn (BNL); CAUCAL, Paul (BNL); VENUGOPALAN, Raju (BNL)

Presenter: SALAZAR, Farid (UCLA)

Session Classification: ep processes

Contribution ID: 14

Type: **not specified**

Next-to SV resummed Drell-Yan cross section beyond leading-logarithm

Friday, 19 November 2021 15:00 (20 minutes)

We present the resummed predictions for inclusive cross section for Drell-Yan (DY) production up to next-to-next-to leading logarithmic ($\overline{\text{NNLL}}$) accuracy taking into account both soft virtual (SV) and next-to SV (NSV) threshold logarithms. We restrict ourselves to resummed contributions only from quark anti-quark ($q\bar{q}$) initiated channels. The resummation is performed in Mellin- N space. We derive the N -dependent coefficients and the N -independent constants to desired accuracy for our study. The resummed results are matched through the minimal prescription procedure with the fixed order results. We find that the resummation, taking into account the NSV terms, appreciably increases the cross section while decreasing the sensitivity to renormalisation scale. We observe that, at 13 TeV LHC energies, the SV+NSV resummation at $\overline{\text{NLL}}(\overline{\text{NNLL}})$ gives about 8% (2%) corrections respectively to the NLO (NNLO) results for the considered Q range: 150-3500 GeV. In addition, the absence of quark gluon initiated contributions to NSV part in the resummed terms leaves large factorisation scale dependence indicating their importance at NSV level. We also study the numerical impact of N -independent constants and explore the ambiguity involved in exponentiating them. Finally we present our predictions for the neutral Drell-Yan process at various center of mass of energies.

Primary author: SANKAR, aparna (IMSc, India)

Co-authors: Dr A.H, Ajjath (IMSc, Chennai); Dr MUKHERJEE, Pooja (University of Bonn, Germany); Prof. V., Ravindran; Ms TIWARI, Surabhi

Presenter: SANKAR, aparna (IMSc, India)

Session Classification: pp processes

Contribution ID: 15

Type: **not specified**

Evidence for the maximally entangled low x proton in Deep Inelastic Scattering from H1 data

Tuesday, 16 November 2021 16:10 (20 minutes)

Motivated by the Kharzeev-Levin entropy formula which postulates a maximally entangled proton wave function in Deep Inelastic Scattering at low x , we investigate the proposed relation between parton number and final state hadron multiplicity. Contrary to the original formulation we propose to determine partonic entropy from the sum of gluon and quark distribution functions at low x , which we obtain from an unintegrated gluon distribution subject to next-to-leading Balitsky-Fadin-Kuraev-Lipatov evolution. We find that our framework provides a very good description of recently measured H1 data on the final state hadron multiplicity, which provides experimental evidence for the proposed entropy formula. We furthermore provide a comparison based on CTEQ next-to-leading order parton distribution functions, which slightly overshoots the data, but provide in general an acceptable description.

Primary author: Dr KUTAK, Krzysztof (IFJ PAN)

Co-author: HENTSCHINSKI, Martin (Universidad de las Americas Puebla)

Presenter: Dr KUTAK, Krzysztof (IFJ PAN)

Session Classification: Parallel session

Contribution ID: 16

Type: **not specified**

Sudakov resummation from the BFKL evolution

Wednesday, 17 November 2021 14:00 (20 minutes)

Based on: Phys. Rev. D 104, 054039 (2021) [<https://arxiv.org/abs/2105.13915>]

The Leding-Logarithmic (LL) gluon Sudakov formfactor is derived from rapidity-ordered BFKL evolution with longitudinal-momentum conservation. This derivation further clarifies the relation between High-Energy and TMD-factorizations and can be extended beyond LL-approximation as well.

Primary author: NEFEDOV, Maxim (Samara State University)

Presenter: NEFEDOV, Maxim (Samara State University)

Session Classification: Small x

Contribution ID: 17

Type: **not specified**

Curing high-energy instability of the NLO heavy-quarkonium hadroproduction cross section with High-Energy Factorization

Tuesday, 16 November 2021 15:50 (20 minutes)

The energy dependence of the total hadroproduction cross section for pseudoscalar quarkonia is computed via matching of the NLO Collinear-Factorisation (CF) results with Leading-Logarithmic resummation of higher-order corrections $\propto \alpha_s^n \ln^{n-1}(1/z)$ to the CF hard-scattering coefficient, where $z = M^2/\hat{s}$ with \hat{s} being partonic center-of-mass energy squared. The resummation is performed using High-Energy Factorization(HEF). The resummation cures the collinear over-subtraction problem of the Next-to-Leading Order(NLO) CF calculation, stabilizing the high-energy behaviour of the cross section. Predictions of the NNLO $\alpha_s^2 \ln(1/z)$ term of the CF hard-scattering coefficient are made. The matching is performed directly in z -space for the first time using the Inverse-Error Weighting (InEW) matching.

Primary authors: NEFEDOV, Maxim (Samara State University); LANSBERG, Jean-Philippe (IPN Orsay - Paris Sud U. - CNRS/IN2P3); Dr OZCELIK, Melih (Institute for Theoretical Particle Physics, KIT, 76128 Karlsruhe, Germany)

Presenter: NEFEDOV, Maxim (Samara State University)

Session Classification: Parallel session

Contribution ID: **18**Type: **not specified**

Sum rules for triple parton distribution functions

Monday, 15 November 2021 16:30 (20 minutes)

Recent measurements of the triple J/ψ production performed by the CMS collaboration suggest non-negligible contribution from a triple parton scattering (TPS). The CMS results can be seen as a first experimental observation of a TPS process. Unfortunately, due to the absence of experimental fits, triple parton distribution functions (tPDFs), needed for the theoretical computation of TPS cross sections, remain unknown. Therefore, in phenomenological studies of the TPS phenomenon one still has to rely on certain model-dependent assumptions about the shape of tPDFs and their relation to standard single parton distribution functions.

In this talk I will discuss how one can extend the sum rules, previously proposed by Gaunt and Stirling for the double parton distribution functions, to the case of tPDFs and how one can use PYTHIA8 code to construct tPDFs which will approximately obey such sum rules. Additionally, I will demonstrate how one can prove the sum rules for “bare” tPDFs using the light-cone formalism.

Primary authors: FEDKEVYCH, Oleh (University of Genoa and INFN - National Institute for Nuclear Physics (sezione di Genova)); GAUNT, Jonathan (University of Manchester)

Presenter: FEDKEVYCH, Oleh (University of Genoa and INFN - National Institute for Nuclear Physics (sezione di Genova))

Session Classification: Multiparton interactions

Contribution ID: 19

Type: **not specified**

Factorization for quark and gluon lattice TMDs

Tuesday, 16 November 2021 15:50 (20 minutes)

Recent years have seen prominent progress in the first-principles calculation of transverse-momentum-dependent parton distributions (TMDs) from the so-called lattice TMDs, which are equal time correlators that include quasi-TMDs and those from the Lorentz-invariant approach. In this talk, I will show that the lattice TMDs and TMDs are related by a factorization formula which can be rigorously derived in QCD. As a corollary, there is no mixing between quark and gluon sectors, or quark of different flavors, in the matching for lattice TMDs, which implies that their lattice calculations can be much simpler than the collinear parton distributions. We also verify these results at one-loop in perturbation theory.

Primary authors: ZHAO, Yong (Argonne National Laboratory); Prof. STEWART, Iain (Massachusetts Institute of Technology); EBERT, Markus (Max-Planck-Institut für Physik); Ms SCHINDLER, Stella (Massachusetts Institute of Technology)

Presenter: ZHAO, Yong (Argonne National Laboratory)

Session Classification: Parallel session

Contribution ID: 20

Type: **not specified**

In-medium jet evolution via coherent medium induced radiation and scatterings

Thursday, 18 November 2021 14:40 (20 minutes)

We propose a system of evolution equations that describe in-medium time-evolution of transverse-momentumdependent quark and gluon fragmentation functions.

Furthermore, we solve this system of equations using Monte Carlo methods. We use the obtained solutions to construct observables that allow us to see

different behaviour of quark and gluon initiated final-state radiation, i.e. the average transverse momentum $\langle |k| \rangle$ and energy contained

in a cone. In particular, the later allows us to conclude that in the gluon-initiated processes there is less energy in a cone, so that the quark jet

is more collimated.

Primary authors: ROHRMOSER, Martin (Institute of Nuclear Physics, Polish Academy of Sciences); BLANCO, Etienne (IFJ-PAN); KUTAK, Krzysztof (Institute of Nuclear Physics Polish Academy of Sciences); Prof. PŁACZEK, Wiesław (Uniwersytet Jagiellonski Kraków); Prof. TYWONIUK, Konrad (University of Bergen)

Presenter: ROHRMOSER, Martin (Institute of Nuclear Physics, Polish Academy of Sciences)

Session Classification: TMDs

Contribution ID: 21

Type: **not specified**

Precision measurements using soft drop jet mass

Friday, 19 November 2021 14:00 (20 minutes)

Soft drop jet mass is an attractive candidate for precision measurements such as the top mass m_t and the strong coupling constant α_s , as it can be perturbatively calculable to high accuracy besides being more robust against nonperturbative and underlying event corrections. In this talk I will describe the prospects for the top mass and α_s -determination at the LHC using soft drop jet mass by combining state-of-the-art resummed predictions with a field theoretic treatment of nonperturbative power corrections. I will show that the observable is promising for m_t measurement in a definite top mass scheme with $\mathcal{O}(1)$ GeV uncertainty. On the other hand, the dominant uncertainty in the α_s -determination is limited by nonperturbative corrections, and for measurements on $p_T \geq 1$ TeV, is saturated to about 2%.

Primary author: PATHAK, Aditya (University of Manchester)

Presenter: PATHAK, Aditya (University of Manchester)

Session Classification: pp processes

Contribution ID: 22

Type: **not specified**

Measurement of the Drell-Yan transverse momentum dependence over a wide mass range with CMS

Monday, 15 November 2021 18:00 (20 minutes)

The double differential cross sections of the Drell-Yan lepton pair (electron or muon) production, as a function of its invariant mass m_{ll} , transverse momentum p_T , and ϕ^* are measured. Drell-Yan masses between 50 GeV and 1 TeV are investigated. Additionally, a measurement is performed requiring at least one jet in the final state. The collected data correspond to an integrated luminosity of 36.3 fb⁻¹ of proton-proton collisions recorded with the CMS detector at the LHC at the center-of-mass energy of 13 TeV in 2016. Measurements are compared to state-of-the-art predictions based on perturbative quantum chromodynamics including soft gluon resummation. These results correspond to the CMS preliminary results SMP-20-003.

Primary author: LEE, Kyeongpil (ULB)

Presenter: LEE, Kyeongpil (ULB)

Session Classification: pp processes

Contribution ID: 23

Type: **not specified**

Role of parton fragmentation for associated J/psi production at high energies

Friday, 19 November 2021 14:20 (20 minutes)

We investigate the role of parton fragmentation processes for associated gauge boson (Z or W) and J/psi production at the LHC conditions. We focused on new partonic subprocesses, namely, the charmed or strange quark excitation followed by the charmed quark fragmentation $c \rightarrow J/\psi + c$. Additionally we take into account the effects of multiple quark and gluon radiation in the initial and final states. We find that these contributions are important and reduce the gap between the theoretical predictions and experimental results.

Primary authors: PROKHOROV, Andrei (Lomonosov Moscow State University (RU), Joint Institute for Nuclear Research (RU)); Dr LIPATOV, Artem (Skobeltsyn Institute of Nuclear Physics Lomonosov Moscow State University, Moscow); Dr BARANOV, Sergey (Lebedev Physical Institute)

Presenter: PROKHOROV, Andrei (Lomonosov Moscow State University (RU), Joint Institute for Nuclear Research (RU))

Session Classification: pp processes

Contribution ID: 24

Type: **not specified**

Probing gluon number density with electron-dijet correlations at EIC

Wednesday, 17 November 2021 16:50 (20 minutes)

We propose a novel way of studying the gluon number density (the so-called Weizsäcker-Williams gluon distribution) using the planned Electron Ion Collider. Namely, with the help of the azimuthal correlations between the total transverse momentum of the dijet system and the scattered electron, we examine an interplay between the effect of the soft gluon emissions (the Sudakov form factor) and the gluon saturation effects. The kinematic cuts are chosen such that the dijet system is produced in the forward direction in the laboratory frame, which provides an upper bound on the probed longitudinal fractions of the hadron momentum carried by scattered gluons. Further cuts enable us to use the factorization formalism that directly involves the unpolarized Weizsäcker-Williams gluon distribution. We find this observable to be very sensitive to the soft gluon emission and moderately sensitive to the gluon saturation.

Primary author: KUTAK, Krzysztof (Institute of Nuclear Physics Polish Academy of Sciences)

Presenter: KUTAK, Krzysztof (Institute of Nuclear Physics Polish Academy of Sciences)

Session Classification: ep processes

Contribution ID: 25

Type: **not specified**

Investigation of the proton structure with associated Z + heavy jet production at the LHC

Tuesday, 16 November 2021 18:40 (20 minutes)

We consider the production of Z bosons associated with a heavy (charm and beauty) jet at the LHC energies using two scenarios based on the transverse momentum dependent (TMD) parton densities in the proton. First of them employs the Catani-Ciafaloni-Fiorani-Marchesini gluon evolution and is implemented into the Monte-Carlo event generator PEGASUS. The second scheme is based on the Parton Branching approach implemented into the Monte-Carlo event generator CASCADE. We compare the predictions obtained within these two TMD-based approaches with each other, investigate their sensitivity to the TMD gluon densities in the proton and estimate the effects coming from parton showers, double parton scattering mechanism and possible intrinsic charm. Additionally, we compare our predictions with the results of traditional (collinear) pQCD calculations performed with the NLO accuracy. It is shown that the TMD-based results do not contradict LHC experimental data.

Primary authors: MALYSHEV, Maxim (CMS (CMS Fachgruppe QCD)); JUNG, Hannes (CMS (CMS Fachgruppe QCD)); Dr LIPATOV, Artem (Skobeltsyn Institute of Nuclear Physics Lomonosov Moscow State University, Moscow); Dr LYKASOV, Gennady (JINR); Dr TURCHIKHIN, Semen (JINR)

Presenter: MALYSHEV, Maxim (CMS (CMS Fachgruppe QCD))

Session Classification: pp processes

Contribution ID: 26

Type: **not specified**

T-odd transverse-momentum-dependent gluon distributions in a spectator model

Tuesday, 16 November 2021 16:30 (20 minutes)

We perform explorative analyses of the 3D gluon content of the proton via a study of polarized T-odd gluon TMDs at leading twist, calculated in a spectator model for the parent nucleon. Our approach encodes a flexible parametrization for the spectator-mass density, suited to describe both moderate and small- x effects. All these prospective developments are relevant in the investigation of the gluon dynamics inside nucleons and nuclei, which constitutes one of the major goals of new-generation colliding machines, as the Electron-Ion Collider, the High-Luminosity LHC, NICA-SPD, and the Forward Physics Facility.

Primary authors: BACCHETTA, Alessandro (University of Pavia and INFN); CELIBERTO, Francesco Giovanni (ECT*/FBK Trento & INFN-TIFPA); RADICI, Marco (INFN - Pavia)

Presenter: CELIBERTO, Francesco Giovanni (ECT*/FBK Trento & INFN-TIFPA)

Session Classification: Parallel session

Contribution ID: 27

Type: **not specified**

The differential cross section of the single inclusive $e^+ e^-$ annihilation to the hadrons via gamma-production, in the different k_t -factorization frameworks

Thursday, 18 November 2021 15:20 (20 minutes)

For the first time, we study the differential cross section of the single inclusive $e^+ e^-$ annihilation to the hadrons via γ -production, in the different k_t -factorization frameworks, using the transverse momenta of the incoming partons, by apply the KMR and method to calculate the un-integrated parton fragmentation functions (UFFs) from the ordinary integrated one, i.e., the parton fragmentation functions (FFs). The LO sets of DSS library for the input FFs is used. The numerical results are compared with the experimental data in the different energies which are reported by the different collaborations, such as TASSO, AMY, MARK II, CELLO and Belle with the other QCD+fragmentation models. The behaviors of the normalized differential cross sections and the multiplicity versus the “transverse momentum” (p_\perp) are discussed. The final results demonstrate that the KMR and MRW UFFs give a good description of data and there is not much significant difference between the above three schemes. On the other hand, our results become closer to the data for the lower values of p_\perp and the higher values of center of mass energies.

Primary authors: Prof. MODARRES, Majid (University of Tehran); Dr TAGHAVI, Roghieh (University of Tehran)

Presenter: Dr TAGHAVI, Roghieh (University of Tehran)

Session Classification: TMDs

Contribution ID: 28

Type: **not specified**

Soft Gluon Resummation for Dijet Process

Thursday, 18 November 2021 17:40 (20 minutes)

In this talk, we will present our results on the soft gluon resummation in the dijet production processes where the total transverse momentum of the dijet is much smaller than the jet momentum.

Primary author: YUAN, Feng (Lawrence Berkeley National Laboratory)

Presenter: YUAN, Feng (Lawrence Berkeley National Laboratory)

Session Classification: pp processes

Contribution ID: 29

Type: **not specified**

Isolated photon production in the Parton Reggeization Approach with real NLO corrections

Tuesday, 16 November 2021 16:30 (20 minutes)

We study isolated photon production in the Parton Reggeization Approach with NLO corrections originated from subprocesses of additional parton emissions. Two matching schemes are tested. The first one is based on Kt-ordering of emitted partons during Kt-depended evolution, the second one applies rapidity-ordering for factorization of real parton emissions. We compare our predictions for transverse momentum spectra of isolated photons measured at the LHC.

Primary author: SALEEV, Vladimir (Samara National Research University)

Co-author: Mrs KUZNETSOVA, Alina (Samara University)

Presenter: SALEEV, Vladimir (Samara National Research University)

Session Classification: Parallel session

Contribution ID: 30

Type: **not specified**

DPDs in colour space: perturbative splitting and positivity

Monday, 15 November 2021 16:50 (20 minutes)

Double parton scattering (DPS) - the situation where two individual hard interactions happen during a single hadron-hadron collision - is sensitive to all sorts of correlations between two partons inside a hadron, e.g. spin, colour, or spatial separation. Therefore DPS gives access to information about hadron structure not accessible in single parton scattering (SPS). This information is encoded in double parton distributions (DPDs) which are the DPS counterpart of PDFs in SPS.

At small inter-parton distances the leading contribution to DPDs is due to a perturbative splitting mechanism, which makes it possible to calculate DPDs in perturbation theory in this regime. We compute the unpolarized perturbative splitting DPDs at next-to-leading order (NLO) for all possible colour correlations and study their numerical importance compared to the leading order (LO) splitting DPDs.

With these NLO splitting DPDs we can show that positivity bounds for colour space DPDs can be violated. We furthermore find that even at LO positivity can be violated by evolution from lower to higher scales, in contrast to the situation for ordinary PDFs.

Primary author: PLOESSL, Peter Josef (T (Phenomenology))

Presenter: PLOESSL, Peter Josef (T (Phenomenology))

Session Classification: Multiparton interactions

Contribution ID: 31

Type: **not specified**

A Philosophical Perspective on Problems in Physics

Wednesday, 17 November 2021 19:30 (1 hour)

The everyday practice of physicists is to a large extent determined by the scientific problems they are confronted with. The conceptual analysis of scientific problems and how they change, therefore, may allow for a fine-grained investigation of the development of a scientific discipline. In this talk I discuss what constitutes a scientific problem, what its elements are and how they change. I will illustrate the advantages of a more problem-focused approach in understanding the development of modern particle physics and provide a perspective that may shed some light in the assessment of open problems and whether they constitute “genuine” problems.

Primary author: DARDASHTI, Radin (U. Wuppertal)

Presenter: DARDASHTI, Radin (U. Wuppertal)

Session Classification: Intellectual Excursion

Contribution ID: 34

Type: **not specified**

Diphoton production at small transverse momentum: resummation and challenges

Thursday, 18 November 2021 18:20 (20 minutes)

At the LHC, diphoton production constitutes the main background of Higgs production in the diphoton decay and of many new physics models predicting large-mass diphoton resonances. Underestimated theoretical uncertainties and large perturbative corrections have been a long-standing issue over the years with various suggestions. Especially the transverse momentum spectrum has lead to various prescriptions. We present transverse momentum resummed diphoton predictions at the level of $N^3LL'+NNLO$ which include the recently published 3-loop hard and beam functions. We discuss the residual uncertainties and challenges for the transverse momentum distribution and address the effect of hybrid-cone photon isolation.

Primary author: NEUMANN, Tobias (Brookhaven National Laboratory)

Presenter: NEUMANN, Tobias (Brookhaven National Laboratory)

Session Classification: pp processes

Contribution ID: 35

Type: **not specified**

Transverse momentum dependent distributions in dijet and heavy hadron pair production at EIC

Wednesday, 17 November 2021 16:30 (20 minutes)

We discuss the measurement of gluon transverse momentum distribution (TMD) in dijet and heavy hadron pair (HHP) production in semi-inclusive deep inelastic scattering. The factorization of these processes in impact parameter space shows the appearance of a specific new soft factor matrix element on top of angular a complex valued anomalous dimensions. We show in detail how these features can be treated consistently and we discuss a scale prescription for the evolution kernel of the dijet soft function. As a result, we obtain phenomenological predictions for unpolarized and angular modulated cross sections for the electron-ion collider (EIC) using current available information on unpolarized TMD.

Primary author: F. DEL CASTILLO, Rafael (Universidad Complutense de Madrid)

Presenter: F. DEL CASTILLO, Rafael (Universidad Complutense de Madrid)

Session Classification: ep processes

Contribution ID: 36

Type: **not specified**

Dynamical resolution scale fits for TMDs at Next-to-Leading-Order (NLO)

Tuesday, 16 November 2021 16:50 (20 minutes)

The parton-branching solutions of QCD evolution equations have been recently studied. From this approach, a method to construct both collinear and transverse momentum dependent (TMD) parton densities has been formulated. In this formalism, soft-gluon color coherence effects are taken into account by introducing the soft-gluon resolution scale. Both analytical studies and numerical solutions of PB evolution equations in the presence of dynamical resolution scales at Leading-Order (LO) in the strong coupling have been presented. In this talk, we show preliminary results of fits to the high-precision deep inelastic scattering (DIS) structure-function measurements regarding the implications of dynamical resolution scales at Next-to-Leading-Order (NLO) accuracy in the strong coupling. We also illustrate the difference between LO and NLO distributions fits.

Primary authors: Mrs SADEGHI BARZANI, Safura (University of Antwerp, Shahid Beheshti University); Mr HAUTMANN, Francesco (University of Antwerp, University of Oxford); Mrs LELEK, Ola (University of Antwerp); Ms KEERSMAEKERS, Lissa (University of Antwerp); TAHERI MONFARED, Sara (DESY)

Presenter: Mrs SADEGHI BARZANI, Safura (University of Antwerp, Shahid Beheshti University)

Session Classification: Parallel session

Contribution ID: 37

Type: **not specified**

Rapidity correlations in multiperipheral models and high energy QCD

Monday, 15 November 2021 15:20 (20 minutes)

Particle-particle correlations, especially rapidity-rapidity correlations was already an important tool for hadron collider physics since the early 70s. Recently, we studied one-particle rapidity distributions and two-particle rapidity-rapidity correlations at hadron colliders revisiting one of the old models, the Chew-Pignotti multiperipheral model and we were surprised to realize that the predictions were very much in line with the predictions one gets for the minijet radiation by using perturbative high energy QCD. Here, we report on further results we obtain from studying rapidity-rapidity correlations by using the Monte Carlo code BFKLex.

Primary authors: CHACHAMIS, Grigorios (IFT UAM-CSIC); SABIO VERA, Agustin (IFT-CSIC & UAM)

Presenter: CHACHAMIS, Grigorios (IFT UAM-CSIC)

Session Classification: MC generators

Contribution ID: 38

Type: **not specified**

HERAPDF2.0Jets and prospects for parton-branching PDFs with HERA jets data.

Wednesday, 17 November 2021 16:10 (20 minutes)

HERA inclusive and jet data has been used in collinear HERAPDF2.0Jets fits at NLO and NNLO. The addition of the jet data allows a simultaneous fit of parton distribution functions of the proton and determination of the strong coupling $\alpha_s(M_Z)$. In the parton branching (PB) approach, Collinear and TMD parton densities have been determined by fits to inclusive deep inelastic scattering HERA data. This method allows one to simultaneously take into account soft-gluon emission and the transverse momentum recoils in the parton branchings along the QCD cascade. The latter leads to a natural determination of the TMD PDFs in a proton. A crucial development will be to include data from other measurements in a wider kinematic range in order to constrain the TMD PDFs and gain sensitivity to intrinsic transverse momentum contributions. We present very preliminary results for PB TMD fits using the same HERA inclusive and jet data at NLO. The results are compared to the HERAPDF2.0Jets predictions and a prospect of including LHC data sets is discussed.

Primary authors: TAHERI MONFARED, Sara (DESY); WICHMANN, Katarzyna (DESY)

Presenter: WICHMANN, Katarzyna (DESY)

Session Classification: ep processes

Contribution ID: 39

Type: **not specified**

TMD extraction and PDF bias problem

Thursday, 18 November 2021 16:00 (20 minutes)

The extraction of TMD PDF includes PDF as input. In some recent extractions we have observed how the quality of the extraction depends on the selected PDF set. We show here how this problem, the PDF bias, is solved with a flavor dependent model for the non-perturbative TMD input.

Primary author: SCIMEMI, Ignazio

Presenter: SCIMEMI, Ignazio

Session Classification: TMDs

Contribution ID: 40

Type: **not specified**

Azimuthal correlations in Z+jet events

Tuesday, 16 November 2021 18:00 (20 minutes)

We present a measurement of azimuthal correlations in Z+jet events measured by CMS at $\sqrt{s}=13$ TeV. The measurements are compared to predictions at NLO using Pythia8 parton shower and hadronization as well as Parton Branching TMDs and TMD shower.

Predictions are given for the back-to-back configuration and a comparison of the prediction with measurements of multi-jets in the same kinematic range is shown.

Primary authors: JUNG, Hannes (DESY); YANG, Heng (CMS (CMS Fachgruppe QCD)); WANG, Qun (DESY); BERMUDEZ MARTINEZ, Armando (CMS (CMS Fachgruppe QCD)); MENDIZABAL MORENTIN, Mikel (DESY)

Presenter: YANG, Heng (CMS (CMS Fachgruppe QCD))

Session Classification: pp processes

Contribution ID: 41

Type: **not specified**

Intrinsic kt and DY production at different masses and energies

Monday, 15 November 2021 15:00 (20 minutes)

We present a study of intrinsic kt effects in DY production from very low DY masses up to the Z-boson mass, covering a large range of center-of-mass energies from $\sqrt{s} = 40$ GeV up to LHC energies.

The description of measurements from different experiments is studied with MCatNLO supplemented with Pythia8 as well as with Parton Branching TMDs.

An energy dependent intrinsic kt width is needed to describe the measurements when Pythia8 is used, while a fixed intrinsic kt width works with PB TMDs.

Primary authors: BERMUDEZ MARTINEZ, Armando (CMS (CMS Fachgruppe QCD)); JUNG, Hannes (CMS (CMS Fachgruppe QCD)); MENDIZABAL MORENTIN, Mikel (DESY)

Presenter: MENDIZABAL MORENTIN, Mikel (DESY)

Session Classification: MC generators

Contribution ID: 42

Type: **not specified**

Finite- α_s corrections to Wilson line correlators

Tuesday, 16 November 2021 17:10 (20 minutes)

In high-energy heavy-ion collisions, a quark-gluon plasma is produced. One way to study this exotic type of matter is to analyze the effect it has on high-energy partons traversing it. This leads to a rich phenomenology that commonly is referred to as jet quenching. High-energy partons propagating in the hot and dense medium mainly experience transverse momentum broadening which leads to additional radiative energy loss. The theoretical description of the main mechanisms behind these phenomena has been well known for some time.

One effect the medium has on partons propagating through it, is that their color continuously rotates, an effect that is encapsulated in a Wilson line along their trajectory. When calculating observables, one typically has to deal with traces of two or more medium-averaged Wilson lines. These are usually dealt with in the literature by invoking the large- N_c limit, but exact calculations have been lacking in many cases. In our work [1], we show how correlators of multiple Wilson lines appear, and develop a method to calculate them to all orders in α_s . Specifically, we will focus on the trace of four Wilson lines, which we develop a differential equation for. We will then generalize this calculation to a product of an arbitrary number of Wilson lines, and show how to do the exact calculation numerically, and even analytically in the large- N_c limit.

Even though these results are derived in the context of high- p_T jet processes, they are quite general and can be used in other situations where Wilson line correlators appear.

[1] J. H. Isaksen and K. Tywoniuk, “Wilson line correlators beyond the large- N_c ,” 7 2021 <https://arxiv.org/abs/2107.02542>

Primary authors: ISAKSEN, Johannes Hamre (University of Bergen); Prof. TYWONIUK, Konrad (University of Bergen)

Presenter: ISAKSEN, Johannes Hamre (University of Bergen)

Session Classification: Parallel session

Contribution ID: 43

Type: **not specified**

Transverse-momentum resummation for boson plus jet production at hadron colliders

Tuesday, 16 November 2021 18:20 (20 minutes)

In this talk I discuss the associated production of a vector or Higgs boson with a jet in hadronic collisions. When the transverse momentum of the boson-jet system is much smaller than its invariant mass, the QCD perturbative expansion is affected by large logarithmic terms that must be resummed to all orders. I discuss the all-order resummation structure of the logarithmically enhanced contributions up to next-to-leading logarithmic accuracy. The presented resummation formalism is fully differential in the kinematic variables of the boson-jet system. Soft-parton radiation produces azimuthal correlations that are fully accounted for in this framework. I present explicit analytical results up to next-to-leading order and next-to-leading logarithmic accuracy, that include the exact dependence on the jet radius. I also elaborate on the presence of non-global logarithms for this observable as well as the absence of clustering logarithms when one uses anti-kt jet-clustering.

Primary author: HAAG, Jürg (UZH)

Presenter: HAAG, Jürg (UZH)

Session Classification: pp processes

Contribution ID: 44

Type: **not specified**

Azimuthal correlations in high pt dijet events with PB TMDs

Thursday, 18 November 2021 17:20 (20 minutes)

We present a comparison of predictions obtained with PB TMDs (MG5-aMC+CA3(jj)NLO) with measurements in the back-to-back region.

The presentation is a result of the PB-TMD Monte Carlo school.

The speaker will be selected from the participants of the PB-TMD school.

Primary authors: JUNG, Hannes (DESY); BERMUDEZ MARTINEZ, Armando (CMS (CMS Fachgruppe QCD)); WANG, Qun (DESY)

Presenter: WANG, Qun (DESY)

Session Classification: pp processes

Contribution ID: 45

Type: **not specified**

Hunting stabilization effects of the high-energy resummation via heavy flavor production at the LHC

Wednesday, 17 November 2021 14:20 (20 minutes)

With the aim of targeting for clear signals of the stabilization of the high-energy resummation under higher-order corrections and energy-scale variation, we investigate the inclusive semi-hard production of two bottom-flavored hadrons, as well as a single bottom-flavored hadron accompanied by a light jet. Working within the hybrid high-energy and collinear factorization formalism, which encodes the BFKL resummation of energy logarithms up to NLL accuracy, we present predictions for cross sections differential in rapidity and transverse momentum, and for azimuthal-angle correlations. The fair stability the emergers from the analysis of our distributions motivates our interest toward future studies in wider kinematic ranges, as the ones reachable at new-generation colliding facilities (HL-LHC, the FPF, the EIC, and NICA). Here, our hybrid factorization could serve as an additional tool to improve the standard fixed-order description of heavy-flavored emissions and to possibly gauge the feasibility of precision studies of these channels in the high-energy regime.

Primary authors: CELIBERTO, Francesco Giovanni (ECT*/FBK Trento & INFN-TIFPA); FUCILLA, Michael (Università della Calabria and INFN - Gruppo collegato di Cosenza); IVANOV, Dmitry Yu (Sobolev Institute of Mathematics); MOHAMMED, Mohammed Maher Abdelrahim (Università della Calabria and INFN - Gruppo collegato di Cosenza); PAPA, Alessandro (Università della Calabria and INFN - Gruppo collegato di Cosenza)

Presenter: MOHAMMED, Mohammed Maher Abdelrahim (Università della Calabria and INFN - Gruppo collegato di Cosenza)

Session Classification: Small x

Contribution ID: 46

Type: **not specified**

Factorization for the Transverse Momentum Distributions in SIDIS at Subleading Power

Tuesday, 16 November 2021 14:20 (20 minutes)

Fully differential measurements of the Semi-Inclusive DIS process with polarized beams provide important information on the three-dimensional structure of hadrons. In particular, azimuthal asymmetries of the fragmenting hadron probe interesting new correlations between partons in the hadronic system through novel hadronic distribution functions. In the framework of factorization for transverse momentum distributions (TMDs) some key asymmetries start at subleading order in the power expansion, where the formalism needed to fully relate observables and distributions is not yet under control, being primarily at tree level in the parton model. In this talk I utilize the soft collinear effective theory formalism to answer a few open questions, including providing generalized definitions of the distribution functions that are valid beyond tree level, giving a proof of completeness of the basis of functions, and providing a description of soft dynamical effects. These results enable a QCD description of SIDIS azimuthal asymmetries beyond tree level, and hence provide a framework for systematically improvable relations to the underlying distributions.

Primary authors: GAO, Anjie (Massachusetts Institute of Technology); Prof. STEWART, Iain (Massachusetts Institute of Technology); EBERT, Markus (Max-Planck-Institut für Physik)

Presenter: GAO, Anjie (Massachusetts Institute of Technology)

Session Classification: TMDs

Contribution ID: 47

Type: **not specified**

Disentangling Long and Short Distances in Momentum-Space TMDs

Tuesday, 16 November 2021 14:00 (20 minutes)

The extraction of nonperturbative TMD physics is made challenging by prescriptions that shield the Landau pole, which entangle long- and short-distance contributions in momentum space. The use of different prescriptions then makes the comparison of fit results for underlying nonperturbative contributions meaningless on their own. We propose a model-independent method to restrict momentum-space observables to the perturbative domain. This method is based on a set of integral functionals that act linearly on terms in the conventional position-space operator product expansion (OPE). Artifacts from the truncation of the integral can be systematically pushed to higher powers in Λ_{QCD}/k_T . We demonstrate that this method can be used to compute the cumulative integral of TMDPDFs over k_T in terms of collinear PDFs, accounting for both radiative corrections and evolution effects. This gives a systematic way of correcting the naive picture where the TMDPDF integrates to a collinear PDF, and we find that for the unpolarized distribution the corrections are a percent-level effect. We also show that, when supplemented with experimental data and improved perturbative inputs, these functionals will enable model-independent limits to be put on the nonperturbative OPE contributions in the Collins-Soper kernel and intrinsic TMD distributions.

Primary authors: SUN, Zhiqian (Massachusetts Institute of Technology); MICHEL, Johannes (not set); Prof. STEWART, Iain (Massachusetts Institute of Technology); EBERT, Markus (Max-Planck-Institut für Physik)

Presenter: SUN, Zhiqian (Massachusetts Institute of Technology)

Session Classification: TMDs

Contribution ID: 48

Type: **not specified**

Renormalization of the radiative jet function and its zero-bin subtraction

Friday, 19 November 2021 15:40 (20 minutes)

We show how to compute directly the renormalization/evolution of the radiative jet function that appears in the factorization theorems for $B \rightarrow \gamma \ell \nu$ and $H \rightarrow \gamma \gamma$ through a b -quark loop. We point out that, in order to avoid double counting of soft contributions, one should use in the factorization theorems a subtracted radiative jet function, from which soft contributions have been removed. The soft-contribution subtractions are zero-bin subtractions in the terminology of soft-collinear effective theory. We show that they can be factored from the radiative jet function and that the resulting soft-subtraction function gives rise to a nonlocal renormalization of the subtracted radiative jet function. This is a novel instance in which zero-bin subtractions lead to a nonlocality in the renormalization of a subtracted quantity that is not present in the renormalization of the unsubtracted quantity. We demonstrate the use of our formalism by computing the order- α_s evolution kernel for the subtracted radiative jet function.

Primary authors: EE, June-Haak (Fudan university); Dr BODWIN, Geoffrey T. (High Energy Physics Division, Argonne National Laboratory); Prof. LEE, Jungil (Department of Physics, Korea University); Dr WANG, Xiang-Peng (High Energy Physics Division, Argonne National Laboratory)

Presenter: EE, June-Haak (Fudan university)

Session Classification: Parallel session

Contribution ID: 49

Type: **not specified**

First solutions of the JIMWLK equation with the kinematical constraint

Tuesday, 16 November 2021 16:50 (20 minutes)

In this talk, we describe the implementation of the kinematical constraint within the Langevin formulation of the JIMWLK equation following the proposal of Hatta and Iancu. We present stability and scaling tests and show first comparisons of the solutions without and with the improvement. We also comment on the rapidity evolution rate of the saturation radius.

Primary authors: KORCYL, Piotr (Jagiellonian University); Prof. MOTYKA, Leszek (Jagiellonian University)

Presenter: KORCYL, Piotr (Jagiellonian University)

Session Classification: Parallel session

Contribution ID: 50

Type: **not specified**

Determining Transverse Momentum Dependent Parton Distribution Functions with Monte Carlo generators

Monday, 15 November 2021 14:40 (20 minutes)

Transverse Momentum Dependent (TMD) parton distribution is a very powerful concept for the description of low and high transverse momentum effects in high energy collisions. The Parton Branching (PB) method provides TMD distributions that can be used in parton shower simulations, as already implemented in CASCADE Monte Carlo event generator.

We develop a method, PS2TMD, that allows determining effective TMDs from the standard Monte Carlo parton showers. This method is validated and implemented to successfully reconstruct the PB-TMDs with different configuration settings. We also discuss kinematic shifts in longitudinal momentum distributions from initial state showering and point out the sizable influence of different reconstruction definitions on both collinear and transverse momentum PDFs.

Primary authors: TAHERI MONFARED, Sara (DESY); JUNG, Hannes (CMS (CMS Fachgruppe QCD)); STEEL, Suzanne (None); ZHOU, Yuchen (CMS (CMS Fachgruppe QCD))

Presenter: TAHERI MONFARED, Sara (DESY)

Session Classification: MC generators

Contribution ID: 51

Type: **not specified**

Power corrections in TMD factorization

Tuesday, 16 November 2021 16:10 (20 minutes)

I present the recent studies of power corrections for the transverse momentum dependent (TMD) factorization. A particular emphasis is made on the novel method of TMD operator expansion that yields the TMD factorization theorem on the operator level. This method grants a systematic description of power corrections to TMD factorization, in particular, it naturally introduces the concept of TMD-twist and allows a certain separation of kinematic and genuine power corrections. Also, I present factorized expression at the next-to-leading power (NLP) (at NLO perturbative accuracy), and discuss the evolution properties for TMD distribution of higher TMD-twists.

Primary author: VLADIMIROV, Alexey (Regensburg University)

Presenter: VLADIMIROV, Alexey (Regensburg University)

Session Classification: Parallel session

Contribution ID: 52

Type: **not specified**

Helicity Evolution at Small x : the Single-Logarithmic Contribution

Wednesday, 17 November 2021 15:00 (20 minutes)

We calculate single-logarithmic corrections to the small- x flavor-singlet helicity evolution equations derived previously at the double-logarithmic approximation. The new single-logarithmic part of the evolution kernel sums up powers of $\alpha_s \ln(1/x)$, which are an important correction to the dominant powers of $\alpha_s \ln^2(1/x)$ summed up previously by the double-logarithmic kernel at small values of Bjorken x and with α_s the strong coupling constant. The single-logarithmic terms arise separately from either the longitudinal or transverse momentum integrals. Consequently, the evolution equations we derive not only include the small- x evolution kernel, but they also coincide in assumptions with the leading-order polarized DGLAP splitting functions. We further enhance the equations by calculating the running coupling corrections to the kernel.

Primary authors: TAWABUTR, Yossathorn (The Ohio State University); Dr KOVCHegov, Yuri (The Ohio State University); Dr TARASOV, Andrey (The Ohio State University)

Presenter: TAWABUTR, Yossathorn (The Ohio State University)

Session Classification: Small x

Contribution ID: 53

Type: **not specified**

Measurements of the Z boson production at ATLAS

Monday, 15 November 2021 17:40 (20 minutes)

Precision measurements of the Drell-Yan process at LHC provide most precise tests of perturbative QCD and information about the parton distribution functions for quarks within the proton. We present the measurement of the transverse momentum and $p_{T, \eta}$ distributions of Drell-Yan lepton pairs at 13 TeV. The measurement is corrected for detector inefficiency and resolution and compared with state-of-the-art theoretical calculations. A summary of similar measurements at 7 and 8 TeV is also presented.

Primary author: EZHILOV , Aleksei (ATLAS)

Presenter: EZHILOV , Aleksei (ATLAS)

Session Classification: pp processes

Contribution ID: 54

Type: **not specified**

Transverse momentum distributions in low-mass Drell-Yan lepton pair production at NNLO QCD

Monday, 15 November 2021 18:20 (20 minutes)

The production of lepton pairs at low invariant mass and finite transverse momentum resolves QCD dynamics at the boundary between the perturbative and non-perturbative domains. We investigate the impact of NNLO QCD corrections for the lepton pair transverse momentum distributions at energies corresponding to the BNL RHIC collider and to fixed-target experiments. Satisfactory perturbative convergence is observed in both cases. Only the collider data are found to be well-described by perturbative QCD.

Primary authors: RODRIGUEZ GARCIA, Adrian (ETH Zurich); GEHRMANN, Thomas (University of Zurich); Prof. GEHRMANN-DE RIDDER, Aude (ETH Zurich); Prof. GLOVER, Nigel (Durham University); Dr GAULD, Rhorry (University of Bonn); Dr HUSS, Alexander (CERN); Dr MAJER, Imre (ETH Zurich)

Presenter: RODRIGUEZ GARCIA, Adrian (ETH Zurich)

Session Classification: pp processes

Contribution ID: 55

Type: **not specified**

Parton showers and PDFs ⊕ N3LO preview

Monday, 15 November 2021 14:00 (20 minutes)

Presenter: PRESTEL, Stefan (Lund University)

Session Classification: MC generators

Contribution ID: 59

Type: **not specified**

QCD/QED interference in fixed color parton showers

Monday, 15 November 2021 14:20 (20 minutes)

We assess the effect of QCD/QED interference effects in fixed color parton showers with tree level matrix element corrections.

Presenter: GELLERSEN, Leif (Lund UNiversity)

Session Classification: MC generators

Contribution ID: **60**Type: **not specified**

T-odd effects in QCD and beyond

Friday, 19 November 2021 16:00 (20 minutes)

In this talk we will describe a parallel between phenomenological and symmetry-based descriptions of the process dependence of the Time-reversal-odd phenomena in QCD, such as the Sivers effect, with the goal of defining the essential elements that lead to such process dependence in QCD. With the necessary elements clarified across these two complementary descriptions, this will then serve as a starting point to explore possible generalizations in a different gauge theory.

Primary authors: MANNA, Dylan (University of Michigan); SIGNORI, Andrea (University of Pavia and INFN); AIDALA, Christine (University of Michigan)

Presenter: MANNA, Dylan (University of Michigan)

Session Classification: Parallel session

Contribution ID: 61

Type: **not specified**

Twist decomposition of the proton structure from BK equation

Friday, 19 November 2021 15:40 (20 minutes)

We perform a twist decomposition of the Balitsky-Kovchegov (BK) amplitude for the proton structure functions in the leading logarithmic limit. Assuming a single iteration of the triple pomeron vertex and using the Mellin space technique we discuss the BK corrections for the leading and subleading twist contributions.

Primary authors: SADZIKOWSKI, Mariusz (Jagiellonian University); Prof. MOTYKA, Leszek (Jagiellonian University)

Presenter: SADZIKOWSKI, Mariusz (Jagiellonian University)

Session Classification: Parallel session

Contribution ID: 62

Type: **not specified**

Universality of quantum corrections to transverse momentum broadening

Friday, 19 November 2021 16:00 (20 minutes)

We show that the resummation of double logarithmic corrections to transverse momentum broadening of fast partons in large QCD media in the vicinity of the saturation boundary yields a universal distribution and exhibits anomalous scaling akin to super diffusive processes such as Lévy random walks. This asymptotic, all order result may have implications in the phenomenology of dijet production in pA and AA collisions and provides a new initial condition for small-x evolution that accounts for gluon fluctuations that live within the target.

Primary authors: MEHTAR-TANI, Yacine (BNL); CAUCAL, Paul (BNL)

Presenter: MEHTAR-TANI, Yacine (BNL)

Session Classification: Parallel session

Contribution ID: 63

Type: **not specified**

Zero-jettiness resummation for top-quark pair production at the LHC

Friday, 19 November 2021 14:40 (20 minutes)

The N-jettiness is a useful resolution variable to distinguish between events with a different number of jets in the final state. It has been successfully employed in slicing calculations for colour singlet processes at NNLO and its resummation forms the basis for the Geneva approach to matching NNLO calculations to parton showers. I will discuss the extension of the zero-jettiness resummation for colour-singlet production to include the production of heavy coloured particles at the LHC. Having derived a factorisation theorem for the observable in this process, we have resummed large logarithms up to approximate NNLL' accuracy. I will describe the resummation framework we have developed and outline future applications to slicing calculations and NNLO+PS event generation.

Primary author: LIM, Matthew (DESY)

Presenter: LIM, Matthew (DESY)

Session Classification: pp processes

Contribution ID: 64

Type: **not specified**

Jet production and TMD evolution

Thursday, 18 November 2021 17:00 (20 minutes)

We investigate the TMD evolution contribution to jet production. Calculations of jet production at the LHC using the TMD merging method are presented. The predictions show very good agreement with the data over a wide kinematic range. Lower matching cone radii are preferred by jet events than Z + jets events.

Presenter: BERMUDEZ MARTINEZ, Armando (CMS (CMS Fachgruppe QCD))

Session Classification: pp processes

Contribution ID: 65

Type: **not specified**

Recent results on extractions of quark TMDs

Thursday, 18 November 2021 16:20 (20 minutes)

We review the recent progress on the extraction of TMD PDFs and TMD FFs from global data of Semi-Inclusive Deep-Inelastic Scattering, Drell-Yan and Z boson production. Particular attention will be devoted to the effects of the increase in theoretical accuracy.

Presenter: BACCHETTA, Alessandro (University of Pavia and INFN)

Session Classification: TMDs

Contribution ID: **66**

Type: **not specified**

Closing talk

Friday, 19 November 2021 16:30 (30 minutes)

Presenter: VAN MECHELEN, Pierre (U Antwerp)

Session Classification: Closing talk