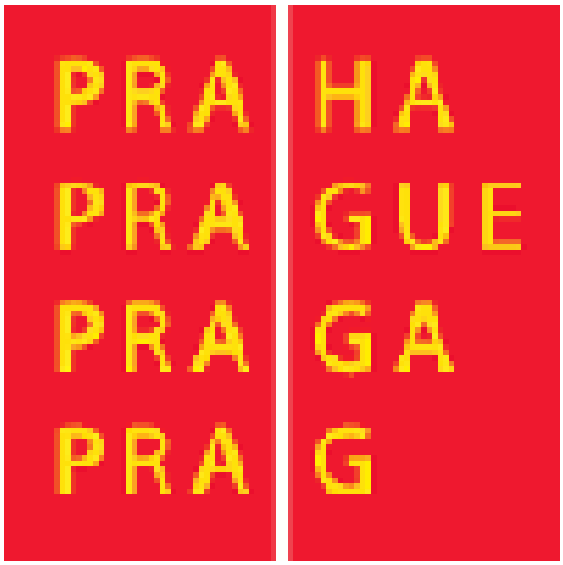
11th International Workshop on Multiple Partonic Interactions at the LHC



Report of Contributions

https://indico.cern.ch/e/816226

Contribution ID: **2** Type: **not specified**

Welcome/Introduction

Monday 18 November 2019 09:00 (10 minutes)

Presenters: IGOR JEX, DEAN OF FNSPE, CTU IN PRAGUE; MYSKA, Miroslav (Czech Technical University (CZ))

Contribution ID: **3** Type: **not specified**

Saturation in the impact-parameter plane through vector meson photoproduction

Thursday 21 November 2019 11:30 (25 minutes)

Up to now, searches for saturation have concentrated in the the small-x behaviour of QCD. Here we add the transverse dimension to this type of studies. We present a model of hadrons with an energy-dependent structure in the transverse plane made of hot spot, regions of high gluonic density. Using this model and the colour-dipole formalism we compute the diffractive photoproduction of vector mesons off protons and show that the dissociative cross section offers a new signature of saturation in the impact-parameter plane. We compare our results to HERA and LHC data and predict that future electron-ion colliders, like JLEIC, eRHIC and LHeC, will be able to map the scale dependece of the associated saturation scale using real and virtual photons as well as different vector mesons.
This work is based on results published in Phys.Lett. B766 (2017) 186-191, Nucl.Phys. B934 (2018) 330-340, and Phys. Rev. D 99, 034025 (2019).

Author: Prof. CONTRERAS NUNO, Jesus Guillermo (Czech Technical University (CZ))

Presenter: Prof. CONTRERAS NUNO, Jesus Guillermo (Czech Technical University (CZ))

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **4** Type: **not specified**

Hadronic Rescattering in Pythia

Wednesday 20 November 2019 10:00 (20 minutes)

We have developed a framework for hadronic rescattering in Pythia. Our goal is to study how rescattering can account for observed phenomena such as flow, jet quenching, etc. In this presentation I will outline our algorithm and present some preliminary results.

Authors: SJOSTRAND, Torbjorn; UTHEIM, Marius (Lund University)

Presenter: UTHEIM, Marius (Lund University)

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **5** Type: **not specified**

Probing double parton scattering via associated open charm and bottom production in ultraperipheral pA collisions

Tuesday 19 November 2019 11:10 (30 minutes)

I will discuss a novel channel for phenomenological studies of the double-parton scattering (DPS) based upon associated production of charm and bottom quark-antiquark pairs in well-separated rapidity intervals in ultra-peripheral high-energy proton-nucleus collisions. This process provides a direct access to the double-gluon distribution in the proton at small-x and enables one to test the factorised DPS pocket formula. I will present the corresponding theoretical predictions for the DPS contribution to this process at typical LHC energies and beyond and validate the use of the energy-independent (but photon momentum fraction dependent) effective cross section.

Author: PASECHNIK, Roman (Lund university)

Co-authors: Dr DE OLIVEIRA, Emmanuel (UFSC, Florianopolis, Brazil); HUAYRA, Edgar (UFSC, Florianopolis, Brazil)

Presenter: PASECHNIK, Roman (Lund university)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **6** Type: **not specified**

Diffractive Bremsstrahlung in hadronic collisions

Monday 18 November 2019 12:00 (30 minutes)

Production of heavy photons (Drell-Yan), gauge bosons, Higgs bosons, heavy flavors and dijets, which is treated within the QCD parton model as a result of hard parton-parton collision, can be considered as a bremsstrahlung process in the target rest frame. In this talk, I will discuss the recent progress and the basic features of the diffractive channels of these processes in the framework of color dipole approach. The main observation is a dramatic breakdown of diffractive QCD factorisation due to the interplay between soft and hard interactions, which dominates these processes. This observation is crucial for phenomenological studies of diffractive reactions in high-energy hadronic collisions.

Author: PASECHNIK, Roman (Lund university)

Presenter: PASECHNIK, Roman (Lund university)

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **7** Type: **not specified**

Double Parton Distributions for the Nucleon on the Lattice

Thursday 21 November 2019 14:25 (20 minutes)

Double parton distributions (DPDs) are an important piece in the descriptions of double hard interactions. On the lattice we calculate correlation functions of two local quark currents, which can be related to Mellin moments of DPDs. For the first moment we calculate all contributing Wick contractions for the nucleon (proton), considering several channels corresponding to the quark polarisation. Furthermore, we test to what extend a factorization into a convolution of generalized parton distributions (GPDs) is valid.

Author: ZIMMERMANN, Christian

Presenter: ZIMMERMANN, Christian

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **8** Type: **not specified**

Charged particle multiplicity dependence of quarkonium production measured by the STAR experiment

Thursday 21 November 2019 16:45 (20 minutes)

Recently, an interesting faster than linear dependence of quarkonium production on charged particle multiplicity in p+p collisions has been observed. This can be used to study basic particle production mechanism and relation between soft and hard QCD processes. Such a strong increase of normalized particle yield from hard processes with respect to normalized charged particle multiplicity may be a sign of saturation effects, string percolation or multiple parton interactions. In order to distinguish among these scenarios, the dependence of quarkonium production on charged particle multiplicity needs to be measured in different p_T ranges and at different collision energies.

In this presentation, the studies of relation between normalized quarkonium yields and normalized charged particle multiplicity in p+p collisions, measured by the STAR experiment, will be presented. These include the results on J/ψ production both at $\sqrt{s} = 200\,\mathrm{GeV}$ and at $\sqrt{s} = 500\,\mathrm{GeV}$. At $\sqrt{s} = 500$ GeV measurements of Υ production will also be shown. The data are shown for different integrated p_T ranges $p_T > 0, p_T > 1.5$ and $p_T > 4$ GeV/c. All these results will be compared to model calculations. In addition, prospects for further studies at the STAR experiment will also be discussed.

Author: Dr KOSARZEWSKI FOR THE STAR COLLABORATION, Leszek (Czech Technical University in Prague)

Presenter: Dr KOSARZEWSKI FOR THE STAR COLLABORATION, Leszek (Czech Technical University in Prague)

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **9** Type: **not specified**

Interferometric Signatures of Hydrodynamics in Small Systems

Wednesday 20 November 2019 09:20 (20 minutes)

Particle interferometry has proven to be an indispensable tool in probing the space-time evolution of femtoscopic collision systems. In this talk, I show how hydrodynamic predictions for the space-time evolution of high-multiplicity pp and p+Pb collisions can be tested against interferometric observables designed to probe their size and shape. In particular, I consider how the dependence of these observables on the transverse momentum K_T and the multiplicity $dN^{\mathrm{ch}}/d\eta$ may reflect the hydrodynamic nature of the evolving system.

Author: PLUMBERG, Christopher

Presenter: PLUMBERG, Christopher

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **10** Type: **not specified**

Measurements of jet fragmentation and jet substructures at ATLAS

In this talk, we present four measurements that probe the internal structure of jets using data collected by the ATLAS experiment. First, a measurement of the properties of jet fragmentation using charged particle tracks is presented, including charged particle multiplicity, jet charge, the summed fragmentation function, the momentum transverse to the jet axis, and the radial profile of the jet are measured. In addition, jet substructure observables are measured in ttbar and inclusive jet events. If available, the measurement of soft drop jet substructure observables in dijet events will be also presented. Finally, a measurement of the Lund Plane is also presented, using charged particles reconstructed inside jets in inclusive jet events. All measurements are performed using proton-proton collision data collected with the ATLAS detector at √s=13 TeV. The measurements are corrected for detector effects and are compared to the predictions of up-to-date Monte Carlo event generators and to the state-of-the-art calculations. New event generator configurations for the modelling of jet production, derived using ATLAS data will also be presented.
ANA-STDM-2017-16
ANA-STDM-2017-34
ANA-STDM-2017-33
ANA-STDM-2018-57
ANA-PMGR-2018-02

Author: ATLAS, Collaboration (ATLAS Collaboration)

Presenter: ATLAS, Collaboration (ATLAS Collaboration)

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **11** Type: **not specified**

Measurement of Underlying Event in Z-boson events at ATLAS

A measurement of charged-particle distributions sensitive to the properties of the underlying event is presented for an inclusive sample of events containing a Z-boson, decaying to a muon pair. The measurement is done using proton-proton collision data collected by the ATLAS experiment at √s=13 TeV. Unfolded differential cross sections are presented for charged particle multiplicity and charged particle transverse momentum in regions of azimuth measured with respect to the Z-boson direction. The data are compared to a wide variety of predictions from Monte Carlo event generators. ANA-STDM-2017-28

Author: ATLAS, Collaboration (ATLAS Collaboration)

Presenter: ATLAS, Collaboration (ATLAS Collaboration)

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **12** Type: **not specified**

Measurements of double parton scattering at ATLAS

Measurements of double parton scattering in proton-proton collisions provide insight into the structure and long-range low-momentum scale interactions of the proton. In this talk we present a measurement of the double-parton scattering contribution to four-lepton events at $\sqrt{s}$=8 TeV. An artificial neural net is used to optimise the analysis and an upper limit on the double-parton scattering fraction is set at 0.042, which corresponds to an effective cross section of 1mb. The data are compared to a wide variety of predictions from Monte Carlo event generators.
ANA-STDM-2017-15

Author: ATLAS, Collaboration (ATLAS Collaboration)

Presenter: ATLAS, Collaboration (ATLAS Collaboration)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **13** Type: **not specified**

Determination of proton parton distribution functions using ATLAS data

Thursday 21 November 2019 11:55 (25 minutes)

We present fits to determine parton distribution functions (PDFs) using top-antitop, inclusive W/Z-boson, as well as W+ and W− boson production measurements in association with jets from ATLAS, in combination with deep-inelastic scattering data from HERA. The ATLAS W and Z boson data exhibit sensitivity to the valence quark distributions and the light quark sea composition, whereas the top-quark pair production data have sensitivity to the gluon distribution. The impact of the top-antitop production data is increased by fitting several distributions simultaneously, with the full information on the systematic and statistical correlations between data points. The parton distribution functions extracted using W+jets data show an improved determination of the high-x sea-quark densities, while confirming the unsuppressed strange-quark density at lower x<0.02 found by previous ATLAS analyses.
ATL-PHYS-PUB-2019-016
ATL-PHYS-PUB-2018-017

Presenter: PACALT FOR THE ATLAS COLLABORATION, Josef (Palacky University (CZ))

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **14** Type: **not specified**

Measurements of single diffraction using forward proton tagging at ATLAS

Tuesday 19 November 2019 15:00 (25 minutes)

Inclusive single diffractive dissociation (pp->pX) is studied using data collected by the ATLAS experiment at the LHC. The intact proton is reconstructed and measured in the ALFA forward spectrometer, while charged particles from the dissociative system (X) are reconstructed and measured using the ATLAS inner tracking detector and calorimeters. Differential cross sections are presented as a function of the proton fractional momentum loss, the four-momentum transfer squared, and the size of a rapidity gap measured from the edge of the ATLAS calorimeters. The results are interpreted in the framework of Regge phenomenology.
ANA-STDM-2018-01

Presenter: TRZEBINSKI FOR THE ATLAS COLLABORATION, Maciej (Polish Academy of Sciences (PL))

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **15** Type: **not specified**

Measurement of colour flow using jet-pull observables in top-quark-antiquark events with the ATLAS experiment at $\sqrt{s}$ = 13 TeV

Wednesday 20 November 2019 09:40 (20 minutes)

Measurements of distributions of two weighted angular moments derived from jet constituents are presented. The jet-pull angle and the jet-pull magnitude, both of which are derived from the jet-pull angular moment, encode the colour connections between partons that seed the jets.
The measurements are performed in top-quark-antiquark events with one leptonically decaying W boson and one hadronically decaying W boson, using 36.1 fb-1 of pp collision data recorded by the ATLAS detector at a centre-of-mass energy of 13 TeV delivered by the Large Hadron Collider. The observables are measured for two dijet systems, corresponding to the colour-connected daughters of the W boson and the two b-jets from the top-quark decays. To allow the comparison of the measured distributions to colour model predictions, the measured distributions are unfolded to particle level, after correcting for experimental effects introduced by the detector. While good agreement can be found for some combinations of predictions and observables, none of the predictions describes the data well across all observables.
Reference: TOPQ-2017-13,
https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/TOPQ-2017-13/

Presenter: PETERS FOR THE ATLAS COLLABORATION, Reinhild (University of Manchester (GB))

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **16** Type: **not specified**

MC study of high multiplicity jet- and UE-biased pp collisions at the LHC energies

Monday 18 November 2019 14:20 (20 minutes)

New measurements on particle production as a function of the charged-particle multiplicity in pp collisions have been reported by the ALICE Collaboration. The novelty of the results relies on the use of transverse spherocity for event classification in either pencil-like or isotropic events, which turn out to be sensitive to the main hard scattering or underlying event, respectively. Results indicate that the average transverse momentum as a function of multiplicity is higher in jetty-like (low spherocity) events than in isotropic (high spherocity) events. While QCD-inspired generators like EPOS LHC and PYTHIA 8 describe the data for minimum bias and isotropic events, the average p_{T} is overestimated by PYTHIA 8 in high multiplicity jetty-like events.

In this work the charged particle production in the toward and transverse regions, relative to the leading-charged particle ($p_{\mathrm{T}}^{\mathrm{leading}} > 4$\,GeV/$c$), are studied as a function of the event multiplicity and event transverse spherocity in pp collisions at $\sqrt{s} = 13$ TeV. The study is conducted using EPOS LHC and PYTHIA 8. We will show that in the 0-10\% most jetty-like events, the UE is not negligible. The contributions of the jet and underlying event to the average p_{T} of high multiplicity jetty-like and isotropic events will be shown. The auto-correlation effects in both two models will be discussed. In this context, the observed tension between data and PYTHIA 8 will be explained.

Author: ORTIZ VELASQUEZ, Antonio (Universidad Nacional Autonoma (MX))

Co-author: VALENCIA PALOMO, Lizardo (Universidad de Sonora (MX))

Presenter: ORTIZ VELASQUEZ, Antonio (Universidad Nacional Autonoma (MX))

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **17** Type: **not specified**

Multi-particle Bose-Einstein correlations in Au+Au collisions at PHENIX

Wednesday 20 November 2019 11:10 (20 minutes)

Exploration of the rich structure of the QCD phase diagram is an important topic in the RHIC heavy ion program whose ultimate goal is to discover the critical endpoint. Investigation of the space-time structure of hadron emissions at various phase transition points using Bose-Einstein correlation of identical bosons will provide insight on the location of the critical endpoint. PHENIX has performed comprehensive measurements of the Bose-Einstein correlation in Au+Au collisions at $\sqrt{s_{NN}}$ = 15, 19, 27, 39, 62.4, and 200 GeV, where we incorporated Levy-type source function to describe the measured correlation functions. We also extended our analysis from two particles to three particle correlations to characterize the nature of the hadron emission source. We put particular focus on one of the parameters in the Levy-type source function, the index of stability α, which is related to one of the critical exponents (the so-called correlation exponent η). We have measured its collision energy and centrality dependence. The three particle correlations confirmed the findings of the two-particle correlations, and also provided insight on pion production mechanism beyond Core-Halo models. We will present the latest PHENIX results on the multi-particle Bose-Einstein correlation, and discuss its physics interpretation.

Author: CSANAD FOR THE PHENIX COLLABORATION, Mate (Eotvos University, Budapest)

Presenter: CSANAD FOR THE PHENIX COLLABORATION, Mate (Eotvos University, Budapest)

Session Classification: Heavy Ions

Track Classification: Heavy Ions

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

Diffractive excitation in pp and pA scattering at high energies

Tuesday 19 November 2019 15:55 (25 minutes)

We present an update of the Miettinen-Pumplim (MP) model for diffractive excitation for proton-proton (pp) and antiproton-proton ($\bar{p}p$) scattering considering recent LHC data. The energy dependence of the total, elastic, and diffractive cross sections are analyzed and compared to data. The implications of the diffractive excitation in proton-nucleus (pA) collisions are also discussed for different nuclei. We used the MP model to derive the main quantities present in the treatment of the diffractive excitation in pA collisions. We demonstrate that the effect of fluctuations decreases at larger energies and heavier nuclei. We also compare our results with the predictions for the proton dissociation induced by photon interactions.

Authors: Prof. GONÇALVES, V.P. (Universidade Federal de Pelotas); Mr PALOTA DA SILVA, R. (Universidade Federal de Pelotas); Dr SILVA, P.V.R.G. (Universidade Federal de Pelotas)

Presenter: Dr SILVA, P.V.R.G. (Universidade Federal de Pelotas)

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **19** Type: **not specified**

Dynamical description of heavy quarks and electromagnetic probes in heavy-ion collisions at ultra-relativistic energies

Wednesday 20 November 2019 11:30 (20 minutes)

Relativistic heavy-ion collisions produce extremely hot dense matter. Heavy flavor and electromagnetic particles are promising probes to investigate the properties of the hot dense matter. The parton-hadron-string dynamics (PHSD) is a Boltzmann-type transport code, but it further includes the off-shellness of particles based on Kadanoff-Baym equations. The equation-of-state and shear viscosity of a partonic matter from lattice QCD calculations are implemented in the PHSD. We use the PHSD to show how heavy flavor mesons and dileptons are produced and modified through the interactions with hot dense matter in relativistic heavy-ion collisions from the SPS to the LHC energies. We have found that not only cold nuclear matter effects such as (anti)shadowing but also hot nuclear matter effects significantly modify the production of heavy flavor particles in relativistic heavy-ion collisions. While intermediate-mass dilepton is mainly contributed from heavy flavor pair in high-energy heavy-ion collisions, the contribution from partonic interactions becomes more dominant as collision energy decreases. It implies that intermediate-mass dilepton in low-energy heavy-ion collisions has a possibility to carry the information of partonic matter.

Authors: Dr SONG, Taesoo (GSI); BRATKOVSKAYA, Elena (GSI, Darmstadt); CASSING, Wolfgang (University of Giessen); Mr MOREAU, Pierre (Goethe University Frankfurt)

Presenter: Dr SONG, Taesoo (GSI)

Session Classification: Heavy Ions

Track Classification: Heavy Ions

Contribution ID: **20** Type: **not specified**

Mueller dipole evolution in Pythia 8

Monday 18 November 2019 14:00 (20 minutes)

This talk focuses on the recent implementation of the Mueller dipole formalism in Pythia 8. We show how the dipole formalism can be used to assign spatial vertices to the MPIs in Pythia 8. This allows us to study geometric quantities such as initial state eccentricities, connected to flow coefficients measured at the LHC. In this work we show comparisons to pp, pPb and PbPb data from the LHC and briefly discuss the forthcoming extensions to UPCs and eA collisions.

Authors: RASMUSSEN, Christine Overgaard (Lund University); BIERLICH, Christian (Lund University (SE))

Presenter: RASMUSSEN, Christine Overgaard (Lund University)

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **21** Type: **not specified**

Multiplicity dependent hadron chemistry from dynamical core–corona initialisation

Tuesday 19 November 2019 10:00 (20 minutes)

Strangeness enhancement reported from the ALICE Collaboration [1] is referred to as an indication of the existence of quark-gluon plasma (QGP) in small colliding systems such as p+p and p+Pb collisions. Yield ratios of strange hadron show continuous increase as a function of multiplicity and saturation in averaged Pb+Pb events when the QGP is supposed to be formed. Motivated by this data, we develop a unified and phenomenological description of QGP formation under the "dynamical initialisation model [2]". We describe the formation of QGP fluids using the hydrodynamic equation with source terms. Just after the collision of nuclei, partons start traversing in vacuum and depositing their four-momentum dynamically. We generate the QGP fluids assuming the deposited four-momentum suddenly get thermalised, i.e. converted into the source of the QGP fluids.

In this work, we develop the dynamical initialisation introducing the core–corona picture:
Local equilibrium is likely to be achieved among highly populated partons due to multi-secondary scatterings, while partons tend to traverse without being QGP components when these are in low-density regions. Under this picture, we dynamically separate the initial partons into the QGP fluids (core: dense/soft components) and surviving partons (corona: dilute/hard components). We utilise the Cooper–Frye formula to obtain final hadron yield from the core, while we perform string fragmentation with PYTHIA [3] for the corona.

We show the (multi-)strangeness yield ratios monotonically increase with multiplicity due to the competition between core and corona components and successfully reproduce the tendency of experimental data [4]. We also calculate the fraction of fluidized energy as a function of multiplicity from small to large systems and find that if we try to describe the experimental data with our model, there should be sizable contributions from the QGP fluids even in averaged p+p collision events.

[1] J. Adam *et al.* [ALICE Collaboration], Nature Phys. **13**, 535 (2017).
[2] M. Okai, K. Kawaguchi, Y. Tachibana and T. Hirano, Phys. Rev. C **95**, no. 5, 054914 (2017).
[3] T. Sjöstrand, S. Mrenna, and P. Z. Skands, Comput. Phys. Commun. **178**, 852 (2008)
[4] Y. Kanakubo, M. Okai, Y. Tachibana and T. Hirano, Progress of Theoretical and Experimental Physics **2018**, no.12, 121D01 (2018).

Author: KANAKUBO, Yuuka (Sophia Univ.)

Co-authors: TACHIBANA, Yasuki (Wayne State University); HIRANO, Tetsufumi (Sophia Univ)

Presenter: KANAKUBO, Yuuka (Sophia Univ.)

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **22** Type: **not specified**

Double parton scattering in jet production processes

Monday 18 November 2019 09:50 (20 minutes)

A composite nature of hadrons leads to a complicated structure of the underlying event in hadronic collisions. In particular it give rise to a possibility to have two hard interactions per one hadron-hadron collision, so called *double parton scattering* (DPS) phenomenon. Among different possible DPS production processes the four-jet DPS production is of particular interest due to a high jet abundance in proton-proton collisions at the LHC.
In this talk, I will consider the four-jet DPS production in proton-proton collisions. In particular, I will discuss the impact of the initial and final state radiation on various DPS sensitive distributions as well as various sets of cuts to increase the fraction of DPS events.

Author: KULESZA, Anna (University of Muenster)

Presenter: FEDKEVYCH, Oleh (INFN - National Institute for Nuclear Physics)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **23** Type: **not specified**

Azimuthal anisotropy of heavy-flavour production with ALICE at the LHC

Monday 18 November 2019 16:40 (20 minutes)

Heavy quarks are sensitive probes to test the properties of the Quark-Gluon Plasma (QGP) state formed in heavy-ion collisions since, due to their large masses, they are formed on timescales shorter than the QGP formation time.
In particular, the measurement of the azimuthal anisotropy of hadrons containing heavy quarks gives insight into the participation of low-momentum heavy quarks in the collective expansion of the system and their possible thermalisation in the medium. Recent measurements of the azimuthal anisotropy in high-multiplicity pp and p–Pb collisions show remarkable similarities with Pb–Pb collisions and suggest the presence of collectivity, whose origin is still debated.
In addition, due to their formation time, heavy quarks are also ideal candidates to probe the strong magnetic field created in heavy-ion collisions by the charged nucleons of the colliding nuclei that do not participate in the collision. In this context, the measurement of the direct flow coefficient of D mesons will give access to fundamental properties of the QGP.

In this contribution, the latest measurements of heavy-flavour azimuthal anisotropies in Pb–Pb collisions and in p–Pb collisions at √s_{NN} = 5.02 TeV with ALICE will be presented. The D-meson azimuthal anisotropy measured with an Event-Shape Engineering technique will be also shown to investigate the influence of initial geometry fluctuations on heavy-flavour production.

Author: Dr LUPARELLO FOR THE ALICE COLLABORATION, Grazia (INFN Trieste)

Presenters: Dr LUPARELLO FOR THE ALICE COLLABORATION, Grazia (INFN Trieste); LUPARELLO, Grazia (Universita e INFN Trieste (IT))

Session Classification: Heavy Ions

Track Classification: Heavy Ions

Contribution ID: **24** Type: **not specified**

Models for the energy behaviour of MPS effective cross-section

Monday 18 November 2019 10:10 (20 minutes)

We examine currently available data for Double Parton Scattering and discuss the energy behaviour of the extracted effective cross-section. A variety of models is compared with different data sets. We find that processes dominated by gluons initiated DPS, such as 4 jet production, exhibit a rising behaviour as the energy increases. Eikonal models as well as models based on empirical fits to pp elastic cross-section are compared with data.

Authors: Prof. GRAU, Agnes (U. Granada); Dr PANCHERI, Giulia (INFN Frascati Laboratories); Prof. PACETTI, Simone (University of Perugia, italy); Prof. SRIVASTAVA, Yogendra (University of Perugia)

Presenter: Dr PANCHERI, Giulia (INFN Frascati Laboratories)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **25** Type: **not specified**

Improving the selection on MPI using multiplicity and leading charged-particle transverse momentum

Tuesday 19 November 2019 09:20 (20 minutes)

We present a phenomenological study of the number of Multiple Parton Interactions (MPI) as a function of mid-rapidity charged-particle multiplicity and leading transverse momentum ($p_{\mathrm{T}}^{\mathrm{leading}}$) in proton-proton collisions at $\sqrt{s}$ = 13 TeV using the event generator PYTHIA 8.240. We observe important correlations between leading charged particle p_{T} and charged particles multiplicity with MPI. Namely, when we combine both quantities the details of the MPI become more visible compared with the selection based purely on multiplicity. The observed effects survive even when the pseudorapidity interval is increased from $|\eta| < 1$ to $|\eta| < 4$. Similar results are obtained when a selection on the leading partonic transverse momentum is implemented. We have complemented the study documenting the contribution of quarks and gluons collisions to the different $p_{\mathrm{T}}^{\mathrm{leading}}$/multiplicity classes.

Authors: Dr MISHRA, Aditya Nath (ICN-UNAM); ORTIZ VELASQUEZ, Antonio (Universidad Nacional Autonoma (MX)); PAIC, Guy (Universidad Nacional Autonoma (MX))

Presenter: Dr MISHRA, Aditya Nath (ICN-UNAM)

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **26** Type: **not specified**

Production of identified light flavour hadrons as a function of underlying event activity in pp collisions with the ALICE detetector

Thursday 21 November 2019 10:00 (20 minutes)

Various recent measurements of high-multiplicity pp and p-A collisions at LHC energies have revealed, surprisingly, that these small collision systems exhibit some features of the quark-gluon-plasma, e.g. collective behaviour and strangeness enhancement, formerly thought to be achievable only in heavy-ion collisions. A promising method to narrow down the origin of this behaviour is to study the effect of Multi-Parton Interactions (MPIs). As proposed in: "Probing collective effects in hadronisation with the extremes of the underlying event"by T. Martin, P. Skands, and S. Farrington (Eur. Phys. J. C (2016) 76, 299), the mean number of MPIs can be accessed experimentally through the self-normalised charged particle density in the Transverse region where the Underlying Event (UE) dominates: $R_{\mathrm{T}} = N_{\mathrm{Ch,Transverse}}/\langle N_{\mathrm{Ch,Transverse}}\rangle$.

The study of particle production as a function of R_{T} would reveal whether, e.g., the properties of "low-UE"events ($R_{\mathrm{T}} \to 0$) are compatible with equivalent measurements in $e^{+}e^{-}$ collisions (jet universality) and whether the scaling behaviour towards "high-UE"($R_{\mathrm{T}} \to 1$) events exhibits properties of non-trivial soft-QCD dynamics.
In this contribution, the p_{T} spectra of $\pi, \mathrm{K}, \mathrm{p}, \phi$ and Ξ as function of R_{T} are presented in pp collisions at $\sqrt{s} = 13$ TeV. Moreover, the p_{T}-differential particle ratios as function of R_{T} in the Towards (jet region) and Transverse regions are contrasted. This discussion will be complemented with UE measurements at the same collision energy.

Author: VAZQUEZ RUEDA FOR THE ALICE COLLABORATION, Omar (Lund University (SE))

Presenter: VAZQUEZ RUEDA FOR THE ALICE COLLABORATION, Omar (Lund University (SE))

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **27** Type: **not specified**

Hadronization of Deconfinement Matter in Terms of First-Order Phase Transition

Thursday 21 November 2019 16:15 (30 minutes)

The hadronization of the deconfined matter arising in high-energy particle collisions is considered in terms of the first kind phase transition in the multiple flux tube approach. Based on the compactification of the standard (3+1) chromodynamics into $QCD_{xy}+QCD_{zt}$, the rate of hadron production in particle collisions with respect to both the rapidity and p_T distributions is derived in the flux tube approach. The obtained rate strongly depends on the energy of the colliding particles, number of tubes, hadron mass as well as on the temperature of the confinement-deconfinement phase transition. Under the concept of the longitudinal dominance and the transverse confinement in a flux tube, and provided that the hadronization process is governed by the phase transition of the first kind, the hadron rate is obtained in the explicit form in the multiple tube approach. In the case of the pion production in pp collisions we obtain a good agreement to the experimental results on the pion yield with respect to both the rapidity and p_T distributions.

Author: Prof. KOSHELKIN, Andrew (National Research Nuclear University)

Presenter: Prof. KOSHELKIN, Andrew (National Research Nuclear University)

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **28** Type: **not specified**

ATLAS results on quarkonia and its associated production

Tuesday 19 November 2019 10:50 (20 minutes)

The associated production of vector boson with quarkonia is a key observable for understanding the quarkonium production mechanisms, including the separation of single and double parton scattering components.
This talk will present the latest measurements from ATLAS on quarkonium production, including the associated production of W+J/psi.

Presenter: SMIZANSKA FOR THE ATLAS COLLABORATION, Maria (Lancaster University (GB))

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **29** Type: **not specified**

Simulating Double Parton Scattering with dShower

Thursday 21 November 2019 15:25 (20 minutes)

In this talk, a new Monte-Carlo simulation of double parton scattering (DPS) at parton level is presented. In this simulation, the dynamics of the 1⟶2 perturbative splittings is consistently included, with the impact-parameter dependence taken into account. The evolution is performed using an angular-ordered parton shower which is combined with a set of double parton distributions that depend explicitly on the inter-parton distance. We present some results from an illustrative study in the context of same-sign WW production at the LHC. In several distributions we see differences compared to DPS models in Herwig, Pythia, and the DPS "pocket formula".

Authors: CABOUAT, Baptiste (University of Manchester); GAUNT, Jonathan Richard (CERN)

Presenters: CABOUAT, Baptiste (University of Manchester); GAUNT, Jonathan Richard (CERN)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **30** Type: **not specified**

Flow as an interplay of fluid-like and non-fluid like excitations

Wednesday 20 November 2019 11:50 (20 minutes)

To study the microscopic structure of quark-gluon plasma produced in hadronic collisions, data must be confronted with models that go beyond fluid dynamics. In order to illustrate the importance of non-fluid like excitations in small systems such as pp and pA collisions, I shall discuss the interplay of fluid-like and non-fluid like excitations in a simple kinetic theory model that encompasses fluid dynamics but contains also particle-like excitations in a boost invariant setting with no symmetries in the transverse plane and with large initial momentum asymmetries. This kinetic theory is confronted with data on azimuthal flow coefficients over a wide centrality range in PbPb collisions at the LHC, in AuAu collisions at RHIC, and in pPb collisions at the LHC. In this way, I shall present the evidence that non-hydrodynamic excitations make the dominant contribution to collective flow signals in pPb collisions at the LHC and contribute significantly to flow in peripheral nucleus-nucleus collisions, while fluid-like excitations dominate collectivity in central nucleus-nucleus collisions at collider energies.

Authors: KURKELA, Eero Aleksi (CERN); WIEDEMANN, Urs (CERN); WU, Bin (CERN)

Presenter: WU, Bin (CERN)

Session Classification: Heavy Ions

Track Classification: Heavy Ions

Contribution ID: **31** Type: **not specified**

W+dijet production in pA collisions via DPS revisited

Thursday 21 November 2019 14:45 (20 minutes)

W boson creation associated with dijet production is a promising channel to study double parton interactions at the LHC. In this talk we review and update predictions for the W+jets signal in proton lead collisions and discuss a new method which could give access to longitudinal and/or transverse structure of the proton.

Author: CECCOPIERI, Federico Alberto (Universita & INFN, Milano-Bicocca (IT))

Presenter: CECCOPIERI, Federico Alberto (Universita & INFN, Milano-Bicocca (IT))

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **32** Type: **not specified**

MC developments in small-x and diffraction

Monday 18 November 2019 11:00 (35 minutes)

In this talk we review current developments regarding small-x and diffractive physics from the viewpoint of Monte Carlo Event Generators. Besides highlighting advances in describing diffractive events we also point out where further work is necessary.

Author: KIRCHGAESSER, Patrick

Presenter: KIRCHGAESSER, Patrick

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **33** Type: **not specified**

Update on Herwig 7

Thursday 21 November 2019 10:20 (20 minutes)

Recent progress in the development of the general purpose Monte Carlo generator Herwig 7 will be presented. A focus will be given to progress in modeling underlying event and minimum bias.

Author: GIESEKE, Stefan (Karlsruhe Institute of Technology)

Presenter: GIESEKE, Stefan (Karlsruhe Institute of Technology)

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **34** Type: **not specified**

Shoving mechanism in PYTHIA8

Monday 18 November 2019 15:00 (20 minutes)

The interaction force between Lund strings contributes to the flow effects in high-multiplicity pp and AA collisions. Hence, it is important to know how much push can this force exert on the strings, whose effects might be observed in the system as a whole. In this talk, we present our shoving mechanism implemented in the Lund string model. This mechanism, along with rope hadronization and colour reconnection processes, makes PYTHIA better equipped to explain collectivity effects in high-multiplicity p-p, p-A and A-A collisions. We present preliminary results of our shoving model on e+e- and p-p angular correlation studies.

Authors: BIERLICH, Christian (Lund University (SE)); Ms CHAKRABORTY, Smita (Lund University); GUSTAFSON, Gosta (Lund University); LÖNNBLAD, Leif (Lund University (SE))

Presenter: Ms CHAKRABORTY, Smita (Lund University)

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **35** Type: **not specified**

Evolution of light- and heavy-flavor hadron production in pp collisions from low to high multiplicity at ALICE

Thursday 21 November 2019 17:25 (20 minutes)

Measurements of the production of light- and heavy-flavor hadrons are of great importance for studies of the matter produced in high-energy collisions. The ALICE experiment has excellent tracking and particle identification capabilities, which have been used to measure a wide variety of hadrons as a function of multiplicity in pp collisions. Studies of light- and heavy-flavor hadrons in high-multiplicity pp collisions have revealed intriguing qualitative similarities to observations in larger collision systems. An overview of the multiplicity dependence of light- and heavy-flavor hadron production in pp collisions at LHC energies will be presented. Topics covered will include strangeness enhancement, the production of light (anti-)nuclei and hadronic resonances, the enhancement of baryon production at intermediate transverse momenta, and charm production. These results will be compared to phenomenological models, with an emphasis on the effects of multiple partonic interactions, as well as results from other collision systems and energy regimes.

Presenter: Dr TRZECIAK FOR THE ALICE COLLABORATION, Barbara Antonina (Czech Technical University in Prague)

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **36** Type: **not specified**

Very-forward neutral particles production measured by the LHCf experiment

Tuesday 19 November 2019 17:10 (25 minutes)

The LHC-forward (LHCf) experiment is dedicated to the measurement of the very forward neutral particle production cross section in proton-proton and proton-lead collisions at the Large Hadron Collider at CERN. The experiment employs two independent detectors, named Arm1 and Arm2, which are placed on opposite sides along the beam line approximately 140 meters away from the interaction point of the ATLAS experiment. Both detectors are composed of two sampling calorimeters. Each calorimeter employs 16 Gd_2SiO_5 (GSO) scintillator layers alternated with tungsten layers. The transverse impact position of the incident particle is measured with GSO bars in Arm1 and silicon micro-strip detectors in Arm2. The experiment can measure particles with pseudorapidity greater than 8.4, up to zero-degree.
The measurement of the very forward secondary particles produced in high energy hadronic collisions is strictly correlated with the study of the ultra-high-energy cosmic rays (UHECRs). Since UHECRs can only be measured with ground-based experiments, detailed Monte Carlo simulations of the shower of secondary particles produced by the interaction of the primary cosmic ray with the atmosphere (the so called "air-showers") must be employed. Most of the energy flow of an air-shower is concentrated in the very-forward region where soft quantum chromodynamics processes dominate, so phenomenological hadronic interaction models must be used in the simulations. The discrepancy between the predictions of different models gives the main contribution to the uncertainty on the measurements of UHECRs spectrum and mass composition. The tuning of hadronic interaction models in the very-forward region with data of accelerator experiments can therefore reduce the systematic uncertainty of UHECRs measurements.
In this contribution the LHCf main physics results from the Run II of LHC will be presented. At first, the results on photon and neutron production cross section in p-p collisions at 13 TeV will be shown. The comparison of the experimental data with some of the commonly used hadronic interaction models (DPMJET, EPOS, PYTHIA, QGSJET and SIBYLL) will be also discussed. Then, the motivation of the combined analysis of LHCf with the ATLAS experiment will be explained. In particular, the number of tracks recorded in ATLAS central detectors are used to discriminate low-mass diffraction interactions. The preliminary results of LHCf-ATLAS combined photon analysis will then be presented and compared with models predictions. Finally, the first preliminary results of $\pi 0$ transverse momentum spectrum in proton-proton collisions at 13 TeV will be shown. Even if there is not a single hadronic interaction model with a good agreement with data in the whole energy and pseudorapidity range, measured data lie mostly between models predictions. The tuning of hadronic interaction models using the experimental data from accelerator experiments, in particular in the very-forward region, can improve the precision of the Monte Carlo simulations and reduce the discrepancy between different models.

Author: TIBERIO FOR THE LHCF COLLABORATION, Alessio (INFN, Firenze (IT))

Presenter: TIBERIO FOR THE LHCF COLLABORATION, Alessio (INFN, Firenze (IT))

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **37** Type: **not specified**

η_c(1S) and η_c(2S) production at the LHC

Thursday 21 November 2019 12:20 (25 minutes)

We present results of calculations of cross sections for production of η_c(1S) and η_c(2S) for the LHC for $\sqrt{s}$ = 7, 8, 13 TeV.
The calculations are performed within k_t-factorization approach for different unintegrated gluon distributions from the literature.
Some of UGDFs include saturation effects.
We discuss effect of the transition $g^*g^* \to \eta_c$ form factors obtained from $c\bar{c}$ wave functions.
The results are compared with existing LHCb data for η_c(1S).
A range of x_1, x_2 and k_{1t}, k_{2t} will be discussed.
A comment on UGDFs will be made.

Author: SZCZUREK, Antoni (Institute of Nuclear Physics)

Presenter: SZCZUREK, Antoni (Institute of Nuclear Physics)

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **38** Type: **not specified**

Double parton scattering at CMS

Monday 18 November 2019 09:10 (20 minutes)

A summary of results on double parton scattering processes from CMS will be presented. The focus of the talk will lie on the latest result on WW production via double parton scattering. The data set in use is from the Run-II data taking periods in 2016 and 2017, corresponding to an integrated luminosity of 77.4 fb-1. The result constitutes the first evidence of this process, with an observed significance of 3.9 standard deviations. An outlook will be given on this interesting process in order to spark discussion on its interpretation in terms of theoretically more sophisticated models of double parton interactions.

Author: DÜNSER FOR THE CMS COLLABORATION, Marc (CERN)

Presenter: DÜNSER FOR THE CMS COLLABORATION, Marc (CERN)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **39** Type: **not specified**

Monte Carlo Modelling and Tuning in CMS

Tuesday 19 November 2019 14:20 (20 minutes)

A new set of CMS underlying-event tunes is presented for the PYTHIA 8 event generator. The tunes use the NNPDF3.1 parton distribution functions at leading (LO), next-to-leading (NLO), or next-to-next-to-leading (NNLO) order in perturbative QCD, and the strong coupling amd PDF evolution at LO or NLO. Comparisons of the predictions of the new tunes are provided for observables sensitive to the global underlying event, to soft multiparton interactions, and to double-parton scattering contributions, as well as for observables measured in various final states, such as multijet, Drell-Yan, and top quark-antiquark pair production. The measurements characterizing the properties of the underlying event in top quark pair production and the Drell-Yan processes are also presented.

Author: Dr CANDELISE FOR THE CMS COLLABORATION, Vieri (Universita e INFN Trieste (IT))

Presenter: Dr CANDELISE FOR THE CMS COLLABORATION, Vieri (Universita e INFN Trieste (IT))

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **40** Type: **not specified**

Run 2 results on Minimum Bias and Underlying Event by CMS

Monday 18 November 2019 14:40 (20 minutes)

The talk will present the results obtained by the CMS collaboration on minimum bias processes and the so-called underlying event. An overview of what we learned during the whole Run 2 of the LHC will be provided.

Presenter: MEHTA FOR THE CMS COLLABORATION, Ankita (Eötvös University, Budapest)

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **41** Type: **not specified**

CMS results on diffraction and exclusive production

Tuesday 19 November 2019 16:20 (25 minutes)

An overview of recent diffractive and exclusive measurements with CMS is given. Results on jet-gap-jet event topologies are shown, together with central exclusive p-p production. Diffractive dijet production is measured with proton tagging in pp collisions. In addition, recent results on exclusive rho0 and upsilon production in pPb collisions at 5.02 TeV are presented.

Presenter: MEHTA FOR THE CMS COLLABORATION, Ankita (Eötvös University, Budapest)

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **42** Type: **not specified**

Collectivity in small systems with the CMS experiment

Wednesday 20 November 2019 09:00 (20 minutes)

Collectivity in small systems with the CMS experiment

Presenter: PUJAHARI FOR THE CMS COLLABORATION, Prabhat Ranjan (Indian Institute of Technology Madras (IN))

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **43** Type: **not specified**

Double-Parton-Scattering studies with quarkonia

Tuesday 19 November 2019 11:40 (20 minutes)

I will review the status and prospects of studies of Double Parton Scatterings with associated and pair production of quarkonia. This includes J/psi pairs, Upsilon pairs, Upsilon+J/psi, J/Psi+D, Upsilon+D, J/psi+Z and J/psi+W at the LHC and the Tevatron.

Authors: LANSBERG, Jean-Philippe (Centre National de la Recherche Scientifique (FR)); LANSBERG, Jean-Philippe (IPN Orsay, Paris Saclay U. / IN2P3-CNRS)

Presenter: LANSBERG, Jean-Philippe (IPN Orsay, Paris Saclay U. / IN2P3-CNRS)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **44** Type: **not specified**

Bose–Einstein correlations of charged hadrons in proton-proton collisions at the CMS experiment

Tuesday 19 November 2019 14:00 (20 minutes)

Bose-Einstein correlations of charged hadrons provide a tool to investigate the space-time structure of the hadron emitting source. In CMS we measure charged hadrons over a broad multiplicity range, from a few particles up to about 250 reconstructed charged hadrons in proton-proton collisions 13 TeV. Different analysis techniques were used to investigate the dependence on simulations when removing the non-Bose-Einstein background from the correlation functions. The measured correlation radii were studied as functions of particle multiplicity and average pair transverse momentum. The results were compared to theoretical predictions, pointing out interesting similarities and differences in hadron production in heavy ion collisions as well.

Author: CSANAD FOR THE CMS COLLABORATION, Mate (Eotvos University, Budapest)

Presenter: CSANAD FOR THE CMS COLLABORATION, Mate (Eotvos University, Budapest)

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **45** Type: **not specified**

A complete picture of photon-initiated production at the LHC

Tuesday 19 November 2019 16:45 (25 minutes)

In this talk we present results of a new calculation and Monte Carlo implementation of photon-initiated production in LHC proton-proton collisions. This includes a precise, differential evaluation of both inclusive and semi-exclusive channels, that is with and without rapidity gaps in the final state. Details of the underlying formalism as well as phenomenological results will be presented.

Author: Dr HARLAND-LANG, Lucian (University of Oxford)

Presenter: Dr HARLAND-LANG, Lucian (University of Oxford)

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **47** Type: **not specified**

Identified-hadron pt spectra and collectivity in small systems

Certain data features that were attributed to quark-gluon plasma (QGP) formation in more-central A-A collisions – evidence for radial flow and jet quenching in pt spectra, v2, v3, etc. in azimuth correlations, one or two "ridge" structures in long-range angular correlations – have more recently been observed in high-multiplicity p-A and even p-p collisions. Arguing by analogy with A-A collisions it is suggested that a flowing dense medium or QGP may be formed even in small collision systems. Alternatively, one could argue that data features appearing in small low-density systems should not be associated with QGP, and alternative explanations are required for any collision system. In this talk I focus on evidence (or not) for radial flow and jet modification in pt spectra from several collision systems. I present a comparison of identified-hadron (PID) pt spectra from p-p, p-Pb, Au-Au and Pb-Pb collisions. The PID spectra are described with a two-component (soft + hard) model of hadron production. To the statistical limits of spectrum data radial flow is excluded from p-p and p-Pb spectra for any charge multiplicity, and is unlikely in A-A collisions as well. Jet modification is also excluded from p-p and p-Pb collisions, whereas strong modification is evident in more-central A-A collisions as has long been evident. The combined results suggest that QGP formation can be questioned for any collision system and that an alternative non-QGP explanation is required for v2 data.

Author: TRAINOR, Thomas

Presenter: TRAINOR, Thomas

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **48** Type: **not specified**

J/psi + Upsilon associated production and prospects to observe a new heavy tetraquark state

Tuesday 19 November 2019 12:00 (20 minutes)

We consider a new mechanism for prompt simultaneous production of J/ψ and Υ mesons in high energy hadronic collisions. The process is considered as a perturbative production of $B_c^{(*)}$ mesons $g+g \to B_c^{(*)}+\bar{B}_c^{(*)}$ followed by a long-distance final state interaction that rearranges the quarks to form J/ψ and Υ mesons. Passing from $B_c^{(*)}+\bar{B}_c^{(*)}$ configuration to $J/\psi+\Upsilon$ configuration may proceed via a hypothetical resonance state, the tetraquark. The goal of this work is to examine whether the respective cross section is large enough to encourage a direct detection of the tetraquark at the LHC conditions (yes), and whether this hypothesis can help to explain the D0 data without assigning an unusually low value to $\sigma_{\rm eff}$ in the double parton scattering mechanism (no).

Author: Dr BARANOV, Sergey (P.N.Lebedev Institute of Physics)

Presenter: Dr BARANOV, Sergey (P.N.Lebedev Institute of Physics)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **49** Type: **not specified**

Quarkonium measurements in small systems at the LHC

Thursday 21 November 2019 17:05 (20 minutes)

At the LHC energies Multiple Parton Interactions (MPI) are expected to affect not only processes involving soft particle production, but also the hard momentum scales relevant for the production of heavy quarks, such as charm and beauty. Quarkonium measurements in high-multiplicity proton-proton (pp) collisions can shed light on the role of MPI at such hard momentum scales, as well as on the interplay between hard and soft particle production mechanisms.
In this contribution we will discuss the latest results from LHC collaborations on quarkonium production measurements as a function of the charged particle multiplicity in small systems. In particular we will focus on results in pp collisions for center-of-mass energies ranging from 2.76 TeV to 13 TeV and based on multiplicity estimators covering different pseudorapidity regions, in several rapidity and transverse momentum ranges of quarkonium states. Similar measurements in p–Pb collisions at center-of-mass energies of $\sqrt{s_{\rm NN}} = 5.02$ and 8.16 TeV will also be shown. We will discuss these results together with models that implement MPI and some other different theoretical calculations.

Author: FIONDA, Fiorella (University of Bergen (NO))

Presenter: FIONDA, Fiorella (University of Bergen (NO))

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **50** Type: **not specified**

Rivet as an experiment-theory interface for the heavy-ion community

Monday 18 November 2019 16:10 (30 minutes)

The comparison of experimental data and theoretical predictions is crucial for our understanding of the mechanisms for particle production and interactions in hadron collisions at the LHC. The Rivet (Robust Independent Validation of Experiment and Theory) framework was developed for this purpose and is used as a generator-independent system for event generator validation and tuning. It provides a large set of experimental analysis algorithms (called plugins) going along with the published data. Thus, Rivet allows a direct comparison of different generators and experimental data, as well as the preservation of the MC analysis algorithms used.

Originally developed for validation and tuning of models in high energy physics in pp(bar) and ee collisions, Rivet did not fulfill the requirements of many of the heavy-ion analyses: the latter require features like in-situ calibration steps, comparisons of AA and pp collisions, and binning in global event observables. A dedicated effort of the ALICE collaboration together with the Rivet core team and theorists resulted in the first Rivet release with heavy-ion functionalities. It provides the mentioned features as well as more than 10 analyses implemented as heavy-ion plugins using these features. While the development of Rivet is continuing in order to deal with other conceptual and technical difficulties of such analyses, it already provides an interface for the heavy-ion community to start writing their own analysis plugins.

Author: KARCZMARCZYK FOR THE ALICE COLLABORATION, Przemyslaw (Warsaw University of Technology (PL))

Presenter: KARCZMARCZYK FOR THE ALICE COLLABORATION, Przemyslaw (Warsaw University of Technology (PL))

Session Classification: Heavy Ions

Track Classification: Heavy Ions

Contribution ID: **51** Type: **not specified**

Studies of double parton scattering at the LHCb

Monday 18 November 2019 09:30 (20 minutes)

The talk is going to include the latest LHCb results on searches of double parton scattering (DPS) effects in the data, taken by the experiment in proton-proton collisions during Run1 and Run2 of the LHC operation. The measurements are performed for the different final states and mainly focused on the processes involving heavy quarks, which provide the most precise probing of factorization hypothesis for DPS for gluon-mediated processes.

Presenter: SAVRINA FOR THE LHCB COLLABORATION, Daria (M.V. Lomonosov Moscow State University (RU))

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **52** Type: **not specified**

Particle production of charged and light flavor hadrons, π, K, ϕ, p and Ξ, as a function of Transverse Spherocity in pp collisions $\sqrt(s) = 13$ TeV with ALICE at the LHC

Tuesday 19 November 2019 09:40 (20 minutes)

The underlying mechanisms of light flavour production are currently not well understood, although they can be described in the framework of different phenomenological models. pQCD models based on hard scatterings,
such as PYTHIA, describe light flavour production via string-breakings and rope-hadronization.
Statistical thermal models predict that the production of light flavour particles is driven by extensive quantities (i.e temperature) and by the hadron masses. The results presented here aim to isolate the different components of hadron production via a differential analysis based on the transverse spherocity using data collected with the ALICE detector at the LHC. The transverse spherocity allows one to perform a topological selection of events that are "isotropic" (dominated by multiple soft processes) and "jetty" (where a single hard process is responsible for a significant part of the multiplicity).

In this contribution we present a study of inclusive charged-particle production, as well as identified π, K, ϕ, p, and Ξ particle production as a function of charged-particle multiplicity density and transverse spherocity at mid-rapidity, $|\eta| < 0.8$, in pp collisions at $\sqrt(s) = 13$ TeV. The results are presented for two multiplicity estimators covering different pseudorapidity regions. The focus of the inclusive charged-particle measurements is average
p_{T} as a function of multiplicity and transverse spherocity. For identified hadrons, transverse momentum spectra and ratios will be presented for high multiplicity events for both estimators.
Finally, the results obtained with ALICE are compared to different model calculations.

Author: NASSIRPOUR FOR THE ALICE COLLABORATION, Adrian Fereydon (ALICE Collaboration, Lund University (SE))

Presenter: NASSIRPOUR FOR THE ALICE COLLABORATION, Adrian Fereydon (ALICE Collaboration, Lund University (SE))

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **53** Type: **not specified**

MB and MC tuning at LHCb

Monday 18 November 2019 15:20 (20 minutes)

Results from LHCb measuring bulk properties of minimum bias events, as well the inelastic cross-section will be summarized. Using these results, a tuning campaign for Pythia 8, specific to the LHCb fiducial volume, is underway and explores some of the newly available colour reconnection models. Some highlights from this tuning campaign will be presented.

Presenter: ILTEN FOR THE LHCB COLLABORATION, Philip (University of Birmingham (GB))

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **54** Type: **not specified**

Bulk vs Shear viscosity on high multiplicity small collision systems

Wednesday 20 November 2019 10:20 (20 minutes)

High multiplicity events in heavy-ion collisions are still under debate whether they produce an extremely hot and dense matter similar to the QGP formed on heavy atomic nuclei collisions. One of the main characteristics of the formation of this state is that it behaves like a near-perfect fluid, with very tiny shear viscosity. We present an estimate of the shear and bulk viscosity properties of the high multiplicity events in p-Pb and p-p collisions at the current LHC energies in the framework of the color of sources. Moreover, the effects of non-thermal equilibrium shown to be relevant. A comparison among the predictions of the relativistic hydrodynamics and the limits in conformal theory is also shown.

Author: BAUTISTA GUZMAN, Irais (Autonomous University of Puebla (MX))

Presenter: BAUTISTA GUZMAN, Irais (Autonomous University of Puebla (MX))

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **55** Type: **not specified**

Particle production and event shape studies: status and new ideas

Tuesday 19 November 2019 09:00 (20 minutes)

Results on hadron production in high-multiplicity proton-proton (pp) and proton-lead (p–Pb) collisions at the LHC energies have revealed the presence of collective phenomena reminiscent to those observed in lead-lead (Pb–Pb) collisions. The bulk particle production in Pb–Pb collisions cannot be calculated from first principles of QCD and instead relies on thermodynamic and hydrodynamic modelling, which assumes a system in a kinetic and chemical equilibrium. On the other hand, some of the collective effects observed in pp collisions can be qualitatively described by phenomenological models, such as multi-partonic interactions (MPI) and color reconnection (CR), or color ropes and shoving. In order to understand the origins of collectivity in pp collisions it is important to isolate the soft regime of QCD, where such effects are pronounced, from the collisions where hard QCD scatterings dominate. Experimentally this can be done using event shape observables such as transverse spherocity S_{O} or self-normalized charged-particle density R_{T}. In this talk I will overview the current results from double-differential studies of pp collisions and compare them to predictions from several Monte Carlo generators. In addition, I will discuss the future prospects of the event shape studies.

Author: VISLAVICIUS, Vytautas (University of Copenhagen (DK))

Presenter: VISLAVICIUS, Vytautas (University of Copenhagen (DK))

Session Classification: High Multiplicities (small system)

Track Classification: High Multiplicities (small system)

Contribution ID: **56** Type: **not specified**

The electron-ion collider –A collider to unravel the mysteries of hadron structure

Monday 18 November 2019 11:35 (25 minutes)

Understanding the properties of nuclear matter and its emergence through the underlying partonic structure and dynamics of quarks and gluons requires a new experimental facility in hadronic physics known as the Electron-Ion Collider (EIC). The EIC will address some of the most profound questions concerning the emergence of nuclear properties by precisely imaging gluons and quarks inside protons and nuclei such as the distribution of gluons and quarks in space and momentum, their role in building the nucleon spin and the properties of gluons in nuclei at high energies. This presentation will highlight the capabilities of an EIC to unravel the mysteries of hadron structure at low-x.

Author: ASCHENAUER, Elke-Caroline (BNL)

Presenter: ASCHENAUER, Elke-Caroline (BNL)

Session Classification: MPI & Small-x & diffraction

Track Classification: MPI & Small-x & diffraction

Contribution ID: **57** Type: **not specified**

Transverse partonic proton structure via double parton scattering at the LHC

Thursday 21 November 2019 14:00 (25 minutes)

Here we present our studies on the so called double parton distribution functions (dPDFs) and transverse proton structure. Double PDFs appear in the double parton scattering (DPS) cross section in high energy proton-proton and proton nucleus collisions. These new distributions represent a novel and promising complementary tool, w.r.t. TMDs and GPDs, to access the 3D partonic structure of the proton. In fact, dPDFs encode double parton correlations in hadrons which cannot be accessed through, e.g., GPDs. However, up to date, dPDFs are almost unknown, in particular, in its dependence on the transverse distance of partons. In this scenario we consider model calculations in order to investigate the impact of double correlations in dPDFs. We considered a fully relativistic treatment by using the Light-Front approach [1]. In this framework, we showed how dynamical
correlations, induced by the used model, prevent the factorisation of dPDFs in terms of standard PDFs, a common assumption in experimental analyses. We focus our attention also in correlations induced by relativistic effects [2]. However, since dPDFs cannot be directly observed in DPS, we investigated the impact of double correlations effects in the so called effective cross section, σ_{eff}, an essential experimental ingredient for the comprehension of the role of DPS in proton-proton collisions. To this aim, dPDFs have been evolved at the experimental momentum scales through the pQCD evolution procedure. We show how the x dependence of σ_{eff}, being x the longitudinal momentum fraction carried by a parton inside the hadron, can be interpreted as the cleanest evidence of partonic correlations [3]. We have also calculated the DPS cross section for the same sign W pair production process, a golden channel to observe DPS at the LHC. In this analysis, as non perturbative input, dPDFs, evaluated within a constituent quark model, have been used. We showed that partonic correlations could be observed in next LHC run [4]. Furthermore, since indications on the magnitudo of σ_{eff} are available, we also demonstrated how the mean value of σ_{eff} can be related to the mean partonic distance between two parton active in a DPS process [5,6]. Such a procedure allows to link the mean value of an experimental observable to the transverse proton structure.

References
[1] M. Rinaldi et al PRD 87, 114021 (2013); M. Rinaldi et al JHEP 12, 028 (2015); M. Rinaldi et al JHEP 10, 063 (2016) and M. Rinaldi et al PRD 95, 034040 (2017).
[2] M. Rinaldi and F. A. Ceccopieri, Phys. Rev. D 95, no. 3, 034040 (2017)
[3] M. Rinaldi et al PLB 752,40 (2016) and M. Traini et al PLB 768, 270 (2017)
[4] F. A. Ceccopieri et al PRD 95, 114030 (2017).
[5] M. Rinaldi et al, PRD 97, 071501 (2018).
[6] M. Rinaldi and F. A. Ceccopieri, JHEP 09, 097 (2019).

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Presenter: Dr RINALDI, Matteo (Perugia University and INFN, Perugia)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **58** Type: **not specified**

Double parton distributions and heavy-quark mass effects

Tuesday 19 November 2019 12:20 (20 minutes)

Double parton distributions (DPDs) are an essentialingredient in the computation of the full DPS cross sections. Their numerical handling is complicated by their structure, which depends on more than twice the number of parameters with respect to regular PDFs. Furthermore, in order to make phenomenological predictions for DPS, it is necessary to also include heavy-quark contributions in the calculations, and in some cases the effects of their masses.

We developed a library called ChiliPDF, which is able to perform the interpolation and evolution of single and double parton distributions with arbitrary input and in a precise and efficient way. Using this library, we produce for the first time evolved DPDs using NNLO DGLAP evolution and matching at the flavor transition scales. We also present some studies and developments regarding the effect of the heavy-quark masses on DPDs, specifically in the case of perturbative splitting from regular PDFs, which happens in the limit of small interpartonic transverse distance.

Authors: Mr NAGAR, Riccardo (Deutsches Elektronen-Synchrotron DESY); DIEHL, Markus (DESY); TACKMANN, Frank (Deutsches Elektronen-Synchrotron (DE))

Presenter: Mr NAGAR, Riccardo (Deutsches Elektronen-Synchrotron DESY)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **59** Type: **not specified**

Overview of hard and soft probe measurements with STAR at RHIC

Monday 18 November 2019 17:00 (40 minutes)

Studies of hot and dense QCD matter created in high energy heavy-ion collisions at the Relativistic Heavy Ion Collider (RHIC) revealed that the matter resembles properties of strongly coupled liquid with very low viscosity. High statistics data and major upgrades of the STAR experiment opened recently a new era of tomography of the QCD matter at RHIC using hard probes. In particular, the Heavy Flavor Tracker enables precision measurements of open heavy flavor hadrons and the Muon Telescope Detector greatly improves quarkonium measurements. Studies in the heavy flavor sector are accompanied by measurements of jet
properties that provide further insights into the partonic energy loss in the QCD matter. RHIC is also uniquely positioned to map the QCD phase diagram by varying the energy as well as species of collided nuclei and dedicated studies to look for the critical point of the QCD phase diagram are pursued. In this talk, an overview of recent results on hard and soft probes in heavy-ion collisions measured by the STAR experiment will be presented.

Author: BIELCIKOVA FOR THE STAR COLLABORATION, Jana (Czech Academy of Sciences (CZ))

Presenter: BIELCIKOVA FOR THE STAR COLLABORATION, Jana (Czech Academy of Sciences (CZ))

Session Classification: Heavy Ions

Track Classification: Heavy Ions

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

WG2 (Double Parton Scattering) - Summary

Friday 22 November 2019 09:30 (15 minutes)

Presenters: MORAES, Arthur (CBPF - Brazilian Center for Physics Research (BR)); SAVRINA, Daria (M.V. Lomonosov Moscow State University (RU)); MACIULA, Rafal (Institute of Nuclear Physics PAN)

Session Classification: Double Parton Scattering

Contribution ID: **61** Type: **not specified**

WG2 (Double Parton Scattering) - Discussion

Friday 22 November 2019 09:45 (15 minutes)

Presenters: MORAES, Arthur (CBPF - Brazilian Center for Physics Research (BR)); SAVRINA, Daria (M.V. Lomonosov Moscow State University (RU)); MACIULA, Rafal (Institute of Nuclear Physics PAN)

Session Classification: Double Parton Scattering

Contribution ID: **62** Type: **not specified**

WG1 (MC&UE&MB) - Summary

Friday 22 November 2019 10:00 (15 minutes)

Presenters: PAIC, Guy (Universidad Nacional Autonoma (MX)); ILTEN, Philip (University of Birmingham (GB)); MARIANI, Valentina (Universita e INFN, Perugia (IT))

Session Classification: Monte Carlo, MB & UE

Contribution ID: **63** Type: **not specified**

WG1 (MC&UE&MB) - Discussion

Friday 22 November 2019 10:15 (15 minutes)

Presenters: PAIC, Guy (Universidad Nacional Autonoma (MX)); ILTEN, Philip (University of Birmingham (GB)); MARIANI, Valentina (Universita e INFN, Perugia (IT))

Session Classification: Monte Carlo, MB & UE

Contribution ID: **64** Type: **not specified**

WG3 (High Multiplicity) - Summary

Friday 22 November 2019 11:30 (15 minutes)

Presenters: BIERLICH, Christian (Lund University (SE)); ZACCOLO, Valentina (Universita e INFN Trieste (IT))

Session Classification: High Multiplicities (small system)

Contribution ID: **65** Type: **not specified**

WG3 (High Multiplicity) - Discussion

Friday 22 November 2019 11:45 (15 minutes)

Presenters: BIERLICH, Christian (Lund University (SE)); ZACCOLO, Valentina (Universita e INFN Trieste (IT))

Session Classification: High Multiplicities (small system)

Contribution ID: **66** Type: **not specified**

WG4 (MPI&Low-x&Diffraction) - Summary

Friday 22 November 2019 09:00 (15 minutes)

Presenters: RASMUSSEN, Christine Overgaard (Lund University); ZLEBCIK, Radek (Deutsches Elektronen-Synchrotron (DE))

Session Classification: MPI & Small-x & diffraction

Contribution ID: **67** Type: **not specified**

WG4 (MPI&Low-x&Diffraction) - Discussion

Friday 22 November 2019 09:15 (15 minutes)

Presenters: RASMUSSEN, Christine Overgaard (Lund University); ZLEBCIK, Radek (Deutsches Elektronen-Synchrotron (DE))

Session Classification: MPI & Small-x & diffraction

Contribution ID: **68** Type: **not specified**

WG5 (Heavy Ion) - Summary

Friday 22 November 2019 11:00 (15 minutes)

Presenters: MAIRE, Antonin (IPHC - Strasbourg (CNRS-In2p3/Unistra)); SAFARIK, Karel (Czech Technical University (CZ))

Session Classification: Heavy Ions

Contribution ID: **69** Type: **not specified**

WG5 (Heavy Ion) - Discussion

Friday 22 November 2019 11:15 (15 minutes)

Presenters: MAIRE, Antonin (IPHC - Strasbourg (CNRS-In2p3/Unistra)); SAFARIK, Karel (Czech Technical University (CZ))

Session Classification: Heavy Ions

Contribution ID: **70** Type: **not specified**

The underlying event in Pythia in function of multiplicity at 13 TeV

Thursday 21 November 2019 10:40 (20 minutes)

The correlation between the near side and transverse side has been studied with Pythia. Strong correlations between the two regions occur at high multiplicities of above dN/deta of 50 charged particles. The changes occurring in the spectra obtained subtracting the transverse side spectra are reported. We conclude that the results indicate the possibility of parton energy loss in pp collisions.

Author: PAIC, Guy (Universidad Nacional Autonoma (MX))

Presenter: PAIC, Guy (Universidad Nacional Autonoma (MX))

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **71** Type: **not specified**

Overlapping interests between heavy ions and small systems

Wednesday 20 November 2019 12:10 (30 minutes)

Open discussion.

Presenters: MAIRE, Antonin (IPHC - Strasbourg (CNRS-In2p3/Unistra)); BIERLICH, Christian (Lund University (SE)); SAFARIK, Karel (Czech Technical University (CZ)); ZACCOLO, Valentina (Universita e INFN Trieste (IT))

Session Classification: Heavy Ions

Track Classification: Heavy Ions

Contribution ID: **72** Type: **not specified**

Double parton distributions: evolution, initial conditions and transverse momentum dependence

Thursday 21 November 2019 15:05 (20 minutes)

I will present results of my investigations on the topics enumerated in the title based on my joint work with my collaborators.

Author: GOLEC-BIERNAT, Krzysztof (Institute of Nuclear Physics, Cracow)

Presenters: GOLEC-BIERNAT, Krzysztof (Institute of Nuclear Physics, Cracow); GOLEC-BIERNAT, Krzysztof Jan (Institute of Nuclear Physics PAN, Krakow, Poland)

Session Classification: Double Parton Scattering

Track Classification: Double Parton Scattering

Contribution ID: **73** Type: **not specified**

Spacetime Colour Reconnection in Herwig 7

Tuesday 19 November 2019 14:40 (20 minutes)

We present a model for generating spacetime coordinates in the Monte Carlo event generator Herwig 7, and perform colour reconnection by minimizing a boost-invariant distance measure of the system. We compare the model to a series of soft physics observables. We find reasonable agreement with the data, suggesting that pp-collider colour reconnection may be able to be applied in larger systems.

Authors: SIODMOK, Andrzej Konrad (Polish Academy of Sciences (PL)); GIESEKE, Stefan (Karlsruhe Institute of Technology); DUNCAN, Cody (Monash University); BELLM, Johannes (Lund); MYSKA, Miroslav (Czech Technical University (CZ))

Presenter: SIODMOK, Andrzej Konrad (Polish Academy of Sciences (PL))

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **74** Type: **not specified**

Particle physics in extensive air shower cascades

Thursday 21 November 2019 09:30 (30 minutes)

With current large cosmic ray observatories, precise data of extensive air shower cascades is recorded up to primary particle energies of 10^{20}eV. While there is significant progress in understanding cosmic rays in general, and also particle physics in the air shower cascades, there are also tantalizing open questions. The most interesting one is the "muon mystery", which is a strong hint for particle physics beyond the standard description in these cascades at ultra-high energies. The connection between particle physics and cosmic ray air shower observations is presented and discussed. The relation to relevant LHC measurements is highlighted.

Author: ULRICH, Ralf (KIT - Karlsruhe Institute of Technology (DE))

Presenter: ULRICH, Ralf (KIT - Karlsruhe Institute of Technology (DE))

Session Classification: Monte Carlo, MB & UE

Track Classification: Monte Carlo, MB and UE

Contribution ID: **75** Type: **not specified**

Conference Photo

Session Classification: Conference Photo