# 12th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions

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DEJIMA MESSE NAGASAKI


# Report of Abstracts

**Poster Session** / **19**

# Correlation of strangeness production with charged hadrons in proton-proton collisions with ALICE

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Measurements of the relative production of strange hadrons in high-energy hadronic collisions have proven to be an important tool for understanding hadronization. In particular, it has been shown that strangeness is produced more abundantly in high-multiplicity pp and p-Pb collisions at the LHC, a phenomenon known as "strangeness enhancement" that has sparked significant interest in both the experimental and theoretical communities.

In this work, correlations between strange hadrons and high-$p_{\{\mathrm{T}\}}$ charged particles are investigated. The results are shown for both Run 2 and Run 3 data-taking periods, the latter providing a significantly larger amount of data and thus allowing a better determination of strangeness-production mechanisms. As these measurements serve as crucial input for phenomenological models aiming to describe the strangeness enhancement, we also discuss how the models are compared with the data.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **26**

# Flavor, parton-mass, and path-length dependence of energy loss in heavy-ion collisions at the LHC

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We use the parametric approach to analyze jet suppression measured using the nuclear modification factor of inclusive jets, b-jets, and jets from gamma-jet events. With minimum model assumptions, we quantify the magnitude of the average energy loss, its pt-dependence, intial parton-mass dependence, and flavor dependence. Further, we quantify the impact of fluctuations in the energy loss and nuclear PDFs on the measured jet suppression. When employing the Glauber model to infer the information about the collision geometry, we quantify the path-length dependence of the average energy loss. Comparison between the magnitude of the energy loss in 2.76 TeV and 5.02 TeV Pb+Pb collisions along with Glauber modelling allows to perform a transparent exptrapolation of the magnitude of energy loss expected to be measured in upcomming Oxygen-Oxygen collisions. The work presented in this talk represents a new extension of modelling published in PLB 767 (2017) 10 and EPJC 76 (2016) 2, 50 and it should help shedding the light into basic properties of parton energy loss measured at the LHC.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **28**

# Reconstruction of photons and neutral mesons in heavy-ion collisions with MPD at NICA

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The Multi-Purpose Detector (MPD) serves as the main experiment of the NICA complex under construction at JINR. With heavy-ion collisions in the energy range $\sqrt{s_{NN}} = 4 - 11$ GeV, the MPD will scan the baryon-reach region of the QCD phase diagram to look for the first order phase transition and critical end-point. The measurement of direct photon and neutral meson production plays an important role in the physics program of the MPD experiment.

We report results of physics feasibility studies for photon and neutral meson ($\pi^0$ and $\eta$) reconstruction with the MPD detector in Bi+Bi collisions at $\sqrt{s_{NN}} = 9.2$ GeV simulated using realistic event generators. The photon measurements rely on different methods such as identification of photon clusters in the electromagnetic calorimeter (ECAL) and reconstruction of photons in the tracking system as dielectron pairs produced in conversion on detector materials (PCM). Neutral meson signals are studied using the invariant mass method by combining ECAL-ECAL, PCM-PCM and ECAL-PCM photon pairs, the uncorrelated combinatorial background is estimated using event-mixing technique. The developed signal reconstruction techniques are compared and tested versus truly generated signals. Complications for the reconstruction of direct photon signals are discussed.

**Category**:

Experiment

**Collaboration**:

MPD Collaboration

**Poster Session** / **29**

# No-quenching baseline for energy-loss signals in small system collisions

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In this work, we perform computations of inclusive jet and semi-inclusive jet-hadron cross sections for minimum-bias oxygen-oxygen collisions. We compute the no-quenching baseline for the jet nuclear modification factor $R_{AA}$ and jet-, and hadron-triggered semi-inclusive nuclear modification factors $I_{AA}$. We do this with state-of-the-art nuclear parton distribution functions, NLO matrix elements and parton shower. We show significant deviations from unity due to cold-nuclear effects even in the absence of quenching. We demonstrate that the nPDF uncertainties constitute a

major limitation in detecting potentially small energy loss effects in small collision systems. Hadron-triggered observables are in particular sensitive to uncertainties due to the non-trivial correlation of the trigger hadron and analyzed particles. For jet-triggered $I_{AA}$, there exist kinematic regions in which errors cancel down to 2%, overcoming the main limitation of small-system energy loss measurements.

Ref. Jannis Gebhard, Aleksas Mazeliauskas, and Adam Takacs, No-quenching baseline for energy-loss signals in small system collisions, in pre-paration.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **30**

## Factorization and jet functions in heavy-ion collisions

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In this talk we discuss factorization of jet cross sections in heavy-ion collisions based on fixed-order calculations. First, using Glauber modelling of heavy nuclei, a factorized formula for jet cross sections is derived, which involves defining jet functions in QCD medium. Then, we present our result of the jet function for producing a heavy quark-antiquark pair, denoted by $Q\bar{Q}$, at leading order in a static medium. The jet function is found to depend on the virtuality of the hard parton that initiates the jet, showing that the presence of QCD matter allows the production of Q at virtuality where is kinematically forbidden in vacuum jets.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **40**

## Testing the flavour dependence of QCD parton showers using heavy-flavour jet substructure with ALICE

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The parton-flavour-dependent properties of the $1 \rightarrow 2$ splitting processes underpinning parton showers can be uniquely explored using heavy-flavour jets. In this talk, we report a series of charm-tagged jet substructure measurements, using jets tagged with a reconstructed $D^0$ meson. Using the newly collected Run 3 data, these measurements span a large range of jet transverse momenta, allowing us to systematically probe the contribution of mass effects at low jet transverse momenta where the dead-cone angle of the charm quark is significant as well as the contribution of Casimir

colour factor effects at high transverse momenta as the charm-tagged jet sample is quark-enriched. These include measurements of the shared momentum fraction and opening angle of the first splitting in Soft-Drop-groomed jets, which are closely linked to fundamental ingredients of the splitting functions, as well as the number of perturbative splittings across the charm-quark shower. We also report the differences between the jet axes returned by different recombination and grooming schemes, which can be used to constrain the impact of perturbative and non-perturbative contributions to the shower properties. Lastly, we report N-subjettiness observables, specifically the ratio of 2-subjettiness to 1-subjettiness, which can be used to constrain the contribution of gluon splittings to charm quarks at different jet transverse momenta.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **42**

## Probing the shower properties of charm quarks using energy-energy correlators with ALICE

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$N$-point energy correlators are currently attracting both theoretical and experimental interest, as they can be calculated to high order accuracy in perturbation theory and capture many different features contributing to the substructure of jets. The energy-energy correlator (EEC), or two-point correlator, which emphasise the angular structure of the energy flow within jets, allow for a comprehensive study of both the perturbative and non-perturbative aspects of jet structure. Defined as the energy-weighted cross-section of particle pairs inside jets, the EECs, as a function of pair distance, show a distinct separation of the perturbative from the non-perturbative regime, revealing parton-flavour-dependent dynamics of jet formation as well as the confinement of partons into hadrons.

In this talk, we report the first EEC measurement of a heavy-flavour jet, tagged via a fully-reconstructed $D^0$ meson. Comparison to a measurement of EECs in inclusive jets offers valuable insight into flavour dynamics of QCD parton fragmentation and hadronisation, such as the different Casimir factors of quarks and gluons, as well as the mass of heavy quarks. Moreover, we will present comparisons with different Monte Carlo (MC) generators and theoretical predictions. This measurement will serve as a baseline for future studies in heavy ion collisions, probing the interplay of the dead cone and the interactions within the quark-gluon plasma.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **44**

# Dielectron production and topological separation of dielectron sources with ALICE

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Electron-positron pairs with low invariant mass are a versatile tool for studying the properties of the quark-gluon plasma created in ultra-relativistic heavy-ion collisions. Due to their electromagnetic nature and the variety of sources that can produce such pairs, they allow to study the whole space-time evolution of the system undistorted by strong final-state interactions. However, a correct interpretation of the results observed in heavy-ion collisions is impossible without comprehensive studies of low-mass dielectron production in proton–proton collisions, which allow one to investigate in detail the corresponding analysis tools and techniques. For example, prompt dielectrons emitted from the hot medium need to be disentangled from a large physics background originating from semi-leptonic correlated decays of heavy-flavor hadrons. This separation can be studied in detail in pp collisions by investigating prompt and non-prompt dielectron pair production in the intermediate mass region.
In this talk we present the final results on dielectron production in pp collisions from LHC Run 2 and the latest measurements from LHC Run 3 data recorded with the upgraded ALICE detector. In particular the improvements of the separation of prompt and heavy flavour dielectrons based on their characteristic topological properties will be discussed. The presentation will conclude with a discussion of the current status of the dielectron measurements in Pb–Pb collisions.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **62**

# Investigating high-pT v2 with a multi-phase transport model

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Elliptic flow ($v_2$) at high transverse momentum ($p_T$) serves as an important hard probe to study the properties of quark-gluon plasma (QGP). The non-zero high-$p_T$ $v_2$ values observed in experiments are often attributed to the path-length dependence of energy loss in the medium due to the asymmetry in the reaction zone. However, recent findings suggest a potential role for hydrodynamics, similar to its influence on low-$p_T$ flow generation. The origin of high-$p_T$ $v_2$ remains an open question. In this work, we offer a new perspective using a multi-phase transport model, which has succeeded in describing the overall flow and spectra in heavy-ion collisions. We investigate the evolution of high-$p_T$ $v_2$ for partons during the rescattering process and for hadrons after coalescence. By comparing model results with experimental data, we discuss potential methods to differentiate between various mechanisms, shedding new light on understanding the generation of high-$p_T$ $v_2$.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **68**

# Measurement of the transverse momentum ($j_{\mathrm{T}}$) distributions of charged-particle jet fragments in pp collisions at $\sqrt{s}$ = 5.02 TeV with ALICE

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Jet substructure measurements, using the distribution of final state hadrons, provide insight into partonic showers and hadronisation. Observables for such measurements include the transverse momentum ($j_{\mathrm{T}}$) with respect to the jet axis and longitudinal momentum fraction ($z$) of jet constituent particles. ALICE has recently measured the $j_{\mathrm{T}}$ distributions of the jet fragments in proton-proton and proton-lead collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV, which are well-described by parton-shower models. This poster will present a new ALICE measurement of jet fragmentation in pp collisions, which simultaneously extends to multiple dimensions in $j_{\mathrm{T}}$ and $z$ to provide a more detailed picture of the parton shower and fragmentation processes. The measured $j_{\mathrm{T}}$ distributions are characterized by a fit that separately constrains the hadronization and perturbative components of the shower. The final results and their fitted distributions are compared with theoretical predictions.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **69**

# Measurement of multiplicity dependent Xic0 via semileptonic decay channel in pp collisions at 13 TeV with ALICE

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Recent measurements of charm baryon-to-meson production-yield ratio at the LHC have shown a substantial enhancement of charm-baryon production in pp collisions as compared to electron-positron and electron-proton collisions. This evidence currently can be interpreted as a modification of the charm hadronization mechanism in hadronic collisions, disproving the assumption of universality of charm fragmentation across different collision systems. By measuring charm-baryon production in pp collisions over a wide range of transverse momenta, rapidities and energies, a detailed characterization of charm hadronization can be obtained. In addition, by performing the measurements as a function of multiplicity of the collision, further information, such as the dependence of the hadronization process on the color-charge density, can be assessed. In this poster, we report the result of the analysis of the Xic0 baryon, reconstructed from the semileptonic decay channel in pp collisions by using the LHC Run 2 data collected with the ALICE apparatus. The measurement of the baryon-to-meson (Xic0/D0) yield ratio as a function of the event multiplicity in pp collisions at √s = 13 TeV will be shown.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **71**

## Understanding photon TMDs with light front wavefunction

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We have calculated all the T-even photon transverse momentum dependent parton distribution functions (TMDs) using light front wave function. For this work, we have considered photon as a Fock-state of quark antiquark pair. All the 9 T-even TMDs have been presented in the overlap and explicit form of light front wave function. We have found that our result arecoming similar to basic light front quantization (BLFQ) result. Only 3 TMDs are non-zero for the case of real photon, while there are 7 for virtual photon.
We have also presented the unpolarized real photon parton distribution functions (PDFs) in our calculations.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **72**

## Performance of the dielectron analysis in Pb-Pb collisions in Run 3 with ALICE

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Photons and correlated electron-positron pairs (dielectrons) are the ideal probes to study the properties of the medium created in relativistic heavy-ion collisions. They are produced in all stages of the collision and leave the system with no loss of information as they do not interact strongly with the medium. However, at LHC energies, the thermal dielectrons emitted in the early stages of the collision from the quark-gluon-plasma are outnumbered by a large contribution of correlated $e^+e^-$-pairs from semi-leptonic decays of heavy-flavour (HF) hadrons.

The upgrade of the ALICE detector installed during the Long Shutdown 2 is crucial to boost the precision of this measurement. The continuous readout of the TPC allows for higher data acquisition rate of up to 50 kHz in Pb-Pb collisions. Moreover, the new ITS with its reduced material budget and higher granularity significantly improves the pointing resolution, leading to a better topological separation of prompt thermal radiation and $e^+e^-$-pairs from HF hadron decays, and to smaller background from photon conversions in the detector material.

In this poster, the status of the analysis of a large data set of Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV, recorded with the upgraded ALICE detector in 2023, is presented. The electron and positron identification capabilities are evaluated and the impact of the detector upgrades on the dielectron analysis will be shown.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **75**

## Quarkonium suppression in strongly coupled plasmas

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Suppression of open heavy flavor quarks and quarkonia in heavy-ion collisions are among the most informative probes of quark-gluon plasma (QGP). Interpreting the full wealth of data obtained from the collision events requires a precise theoretical understanding of the evolution of heavy quarks and quarkonia as they propagate through strongly coupled plasma.

Such calculations require the evaluation of a gauge-invariant correlator of chromoelectric fields. This chromoelectric correlator encodes all the characteristics of QGP that the dissociation and recombination dynamics of quarkonium are sensitive to, which is to say can in principle measure. In this talk, we will review its calculation and its distinctive qualitative features at weak coupling in QCD up to next-to-leading order and at strong coupling in $\mathcal{N} = 4$ SYM using the AdS/CFT correspondence, as well as its formulation in Euclidean QCD, paving the way for a lattice QCD calculation of it.

Finally, we report on recent progress in applying our results to the calculation of the final quarkonium abundances after propagating through a cooling droplet of QGP, which illustrates how we may learn about QGP from quarkonium measurements. We devote special attention to how the presence of a strongly coupled plasma modifies the transport description of quarkonium, in comparison to approaches that rely on weak coupling approximations to describe quarkonium dissociation and recombination.

Based on 2306.13127 and 2310.09325.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **76**

## Energy-energy correlators in p-Pb collisions at 5 TeV with the ALICE experiment

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Energy-energy correlators (EECs) have been proposed to study the structure of energy flow within jets. These functions are defined as the energy-weighted cross-section of particle pairs inside jets. The correlation as a function of pair distance and jet transverse momentum shows a clear separation between the perturbative and non-perturbative regimes, where one can probe the dynamics of the parton shower of quarks and gluons and their subsequent confinement into hadrons. This poster will show the first measurement of 2-point EECs for inclusive jets in p-Pb collisions at 5 TeV from the ALICE experiment. By comparing this result to a p-p baseline, we will discuss sensitivity to cold nuclear matter effects in p-Pb collisions. We can use this to study changes to jet dynamics caused by interactions between color charges and a cold nuclear medium.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **77**

## Monte Carlo studies of energy-energy correlators for $D^0$-tagged jets in in pp collisions

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Energy-energy correlators (EECs) offer a novel way to study the structure of jets. Defined as the energy-weighted cross section of particle pairs inside jets, the correlation strength as a function of the pair opening angle allows a distinct separation of the perturbative and non-perturbative regimes. The evolution of parton dynamics in jets to their confinement into hadrons can be studied. We present ALICE studies of the EECs for $D^0$-tagged jets in pp collisions at 13 TeV using various Monte Carlo simulations. By comparing our results to EECs in inclusive (gluon-dominated) jets, we can search for modifications in the radiation pattern of jets due to mass effects from the presence of the dead cone or Casimir color factors. We specifically look at the difference between light- and heavy-quark initiated jets, as well as gluon-initiated jets in PYTHIA. We also study the $D^0$-tagged jets that decay from a $D^*$ meson, to measure the contribution of the accompanying soft pion and its effect on the energy correlations. We compare the EECs of $D^0$-tagged jets in PYTHIA, Herwig, and Sherpa to study model differences and hadronization effects. These studies will serve as a baseline for future measurements in heavy-ion collisions, allowing for disentanglement of the dynamics of the dead cone from interactions with the quark-gluon plasma (QGP).

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **81**

# Quarkonia collectivity in proton-proton and Pb-Pb collisions with ALICE

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Quarkonium production is one of the golden probes to study the quark–gluon plasma (QGP). Among many observables, the measurement of azimuthal anisotropies in their production sheds light on the collective behavior of particles in a strongly interacting medium. In particular, the magnitude of the elliptic flow measured at the LHC is interpreted as a signature of the charm-quark thermalization in the QGP, supporting the scenario of charmonium (re)generation at low $p_{\mathrm{T}}$. Interestingly, the measurement of collective-like effects in high-multiplicity pp and p–Pb collisions provides new insights on the evolution of QGP-related observables going from small to large collision systems. In this contribution the measurement of the  flow coefficients in pp and Pb–Pb collisions carried out by the ALICE collaboration will be presented. In addition, the status of further related measurements, possible in Run 3 thanks to the upgraded detector, will be discussed.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **86**

# b-jet cross section measurement using heavy-flavour tagging with secondary-vertex method in pp collisions at 13.6 TeV with ALICE

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This study focuses on the measurement of b-jet production in pp collisions at 13.6 TeV with the ALICE detector. The accurate identification of b-jets is crucial for understanding heavy-flavour quark production and fragmentation. This analysis concentrates on tagging beauty jets using the secondary-vertex method which excels in identifying long-lived hadrons containing a b quark by analyzing the secondary vertex of the hadron's decay and the primary vertex of the collision. In this work we focus on finding secondary vertices containing 3 prongs. Notably, this analysis takes advantage of the Run3 dataset, where updates to the Inner Tracking System (ITS2) have significantly improved the secondary-vertex resolution compared to Run2. This study presents the measurement of b-jet cross sections, highlighting the effectiveness of secondary vertex tagging techniques.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **88**

# Production of $\omega$ mesons in pp collisions at $\sqrt{s} = 5.02$ TeV with ALICE

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Measurements of neutral meson production cross sections in proton-proton (pp) collisions at LHC energies are important as a reference for heavy-ion studies and to test our understanding of QCD. At high transverse momenta ($p_{\mathrm{T}}$) where pQCD is applicable these measurements can be used to constrain model calculations. At low momenta, the production rates of neutral mesons are crucial inputs for measurements of direct photons and dielectrons. Therefore, the production cross-section of the $\omega$ meson at midrapidity needs to be measured down to the lowest $p_{\mathrm{T}}$.

This poster will present the first measurement of the $\omega$ meson at midrapidity in pp collisions at $\sqrt{s} = 5.02$ TeV using the decay channel $\omega \rightarrow \mathrm{e}^{+}\mathrm{e}^{-}$. This analysis extends the low $p_{\mathrm{T}}$ range of previous measurements significantly to $0 < p_{\mathrm{T}} < 6$ GeV/$c$ and enables the determination of the total yield without any extrapolation uncertainties. We will discuss the challenges in the signal extraction and background estimation related to the dielectron measurement. The final results will be shown in comparison to different model calculations as well as to measurements at different collision energies.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **91**

# Minijet quenching in non-equilibrium quark-gluon plasma

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We study the energy deposition and thermalisation of high-momentum on-
shell partons (minijets) travelling through a non-equilibrium Quark-Gluon Plasma using QCD kinetic theory. For thermal backgrounds, we show that the parton energy first flows to the soft sector by collinear cascade and then isotropises via elastic scatterings. In contrast, the momentum deposition from a minijet reaches the equilibrium distribution directly.
For expanding non-equilibrium QGP, we study the time for a minijet perturbation to lose memory of its initial conditions, namely, the hydrodynamisation time. We show that the minijet evolution scales well with the relaxation time τ_R ∝ η/s/T(τ), where T(τ) is the effective temperature and η/s is

the viscosity over entropy ratio. This scaling allows to extract minijet response functions similarly as in KøMPøST, describing macroscopically how initial minijet perturbations deposit their energy and momentum in the medium.

Ref: Fabian Zhou, Jasmine Brewer, Aleksas Mazeliauskas
Minijet quenching in non-equilibrium quark-gluon plasma
arXiv:2402.09298

**Category**:

Theory

**Collaboration**:

**Poster Session** / **97**

## Observing jet quenching using generalized jet angularities in Au+Au collisions at $\sqrt{s_{\rm NN}} = 200$ GeV from STAR

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Jets originating from hard-scattered partons in the early stages of heavy-ion collisions travel through the Quark Gluon Plasma (QGP) and are modified or quenched relative to a $p$+$p$ collision baseline. Moments of the jet's transverse momentum ($p_{\rm T}$) profile in the $\eta - \phi$ plane relative to the jet-axis are an important class of jet substructure observables to study in medium modifications of the jet's radiation and fragmentation patterns called generalized jet angularities. Previous measurements of these angularities have been performed using quenched jets from Pb+Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV in the LHC, and similar measurements using heavy-ion collisions at RHIC energies will probe jet quenching in a region of phase space that is complementary to the region probed in the LHC.

In this study, we present nuclear modification factors ($R_{\rm AA}$) using simultaneous fully corrected measurements of various generalized jet angularities using jets from Au+Au collisions at $\sqrt{s_{\rm NN}} = 200$ GeV and $p$+$p$ collisions at $\sqrt{s} = 200$ GeV collected by the STAR experiment. We also explore a novel machine-learning based method that measures the degree to which quenched and unquenched jets are distinguishable. Both these measurements are differential in centrality of the Au+Au collisions.

**Category**:

Experiment

**Collaboration**:

STAR

**Poster Session** / **98**

## Event-shape engineering of high-momentum probes in Au+Au collisions

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Partonic scatterings with high momentum transfer occur before the formation of the quark-gluon plasma (QGP) in heavy-ion collisions and result in collimated collections of hadrons, called jets. The modification of the high-virtuality parton shower in the QGP compared to that in proton-proton collisions offers insight into the nature of colored probes' interaction with the medium.

To study the path-length dependent effects on hard partons traveling through the QGP, we apply a technique known as event-shape engineering to data from Au+Au collisions at $\sqrt{s_{\rm NN}} = 200$ GeV at STAR – the first such measurement at RHIC. Within a given eccentricity and centrality class, high-momentum probes traveling in the event plane direction (having shorter path length) are compared to those traveling perpendicular to it (having longer path length). By selecting on the centrality, we minimize the effect from variation in energy density. We then report a comparison of the ratios of in-and out-of-plane yields between two eccentricity classes, which reflects the dependence of energy loss on the collision geometry.

**Category**:

Experiment

**Collaboration**:

STAR

**Poster Session** / **101**

## Direct virtual photon production in Au+Au collisions with STAR BES-II data

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As electromagnetic probes, photons have the advantage of escaping unimpeded from their emission source. Consequently, photons can carry valuable information about the properties and dynamics of the hot QCD medium created in heavy-ion collisions. Particularly, the transverse momentum distribution of direct virtual photons emitted from the hot QCD medium exhibits sensitivity to the system temperature. As a result, it offers an effective means of measuring the temperature of the medium.

The STAR experiment has recorded large datasets of Au+Au collisions in the Beam Energy Scan Phase-II (BES-II) program, spanning center-of-mass energies $\sqrt{s_{\rm NN}}$ = 3 - 54.4 GeV. In this talk, preliminary results of the direct virtual photon measurement in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 27 and 54.4 GeV will be presented, including $p_T$-differential invariant yields and total yields in different centrality bin. Furthermore, the effective temperature extracted from the $p_T$ spectra and the physics implications will be discussed.

**Category**:

Experiment

**Collaboration**:

STAR

**Poster Session** / **105**

## Method of semi-inclusive jet mass measurement in Au+Au collisions at sqrt(s_NN) = 200 GeV with STAR

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Jet quenching phenomenon serves as a crucial signature of the Quark-Gluon Plasma, observed when hard-scattered partons interact with the hot, dense QCD medium created in high-energy heavy-ion collisions. In central heavy-ion collisions, however, distinguishing jets produced by hard scattering from those originating from combinatorial background is largely limited, especially for jets with low transverse momenta ($p_{\mathrm{T,jet}}$). To address this challenge, methods for measurements of semi-inclusive recoil jets with respect to a trigger particle have been devised, leading to measurements of jet yields to the unprecedentedly low $p_{\mathrm{T,jet}}$ range. In particular, the STAR Collaboration has combined this semi-inclusive recoil jets measurement with a mixed-event technique as a data-driven method for the correction of uncorrelated background effects. We aim to extend the scope of the semi-inclusive approach into measurements of jet mass ($M_{\mathrm{jet}}$), and develop a 2-dimensional correction framework as a function of ($p_{\mathrm{T,jet}}$, $M_{\mathrm{jet}}$).
In this poster, we discuss the method of semi-inclusive jet mass measurements, and provide the closure test result based on simulation. Jets from PYTHIA events are embedded into $\sqrt{s_{\mathrm{NN}}} = 200$ GeV Au+Au collision background obtained from a thermal model. Correction procedures, including the subtraction of combinatorial jet contributions via a mixed-event technique and 2-dimensional unfolding, are tested.

**Category**:

Experiment

**Collaboration**:

STAR

**Poster Session / 107**

# The modified dilepton production rate from charged pion-pair annihilation in the inhomogeneous chiral condensed phase

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In the context of study of QCD phase diagram, the possibility of inhomogeneous chiral condensed phase in low-temperature and high-density regions has been discussed using the low-energy effective theory of QCD such as the Ginzburg-Landau theory, the Nambu-Jona-Lasinio model and so forth. In such a phase, the lepton production rates may change compared to those of homogeneous chiral condensed phase, which includes a vacuum. In particular, the dilepton production rates from charged pion-pair annihilations are expected to be modified by the pion dispersion relation in the inhomogeneous chiral condensed phase, and this modification may be considered as one of the possible experimental signatures for the existence of that phase.
In this study, we assume a dual chiral density wave as an inhomogeneous chiral condensate, and start from a low energy effective Lagrangian expanded with respect to the order parameter based on O(4) symmetry up to the sixth order because of the low-energy effective model of QCD. Using the dispersion relation of the Nambu-Goldstone modes obtained by our model, we evaluate dilepton production rates by charged pion-pair annihilation as a function of an invariant mass and show how the obtained results may be modified compared with the results of dilepton production rates in the homogeneous chiral condensed phase.

**Category**:

Theory

**Collaboration**:

**Poster Session / 111**

## Jet modification in the QGP and the hadronic phases with SUBA-Jet framework

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We study jet production and modification in lead-lead collisions at the LHC energies within a recently introduced SUBA-Jet framework [1]. The core of the framework is a time-like parton shower that starts with a seed parton with high $Q^2$, as well as realistic fluid dynamic evolution of the medium, simulated using the vHLLE code. The initial seed partons are produced by PYTHIA, whereas the initial state for the medium is modeled with TrENTo model. At particlization, the medium decouples into hadrons, with final-state hadronic rescatterings simulated using the SMASH hadronic transport. The jet partons lose energy in the medium and hadronize. The ingredients above allow to simulate a complete event containing both soft and hard hadrons.
We benchmark the jet energy loss in lead-lead collisions at 5.02 TeV LHC energy in this framework, and, in particular, we examine the influence of hadronic phase on the jet properties. Traditionally, jet modification is assumed to happen solely in the QGP phase, based on arguments of formation time of jet hadrons and low jet transport coefficient in hadronic phase. We argue that the validity of those arguments depends on hadron $p_{\mathrm{T}}$, and as a result the complete jet object can have a visible modification in the hadronic phase, as quantified by different observables.

[1] Iu. Karpenko, A. Lind, M. Rohrmoser, J. Aichelin, P.-B. Gossiaux, arXiv: 2404.14579 [hep-ph]

**Category**:

Theory

**Collaboration**:

**Poster Session / 112**

## Investigating hadronisation and light-nuclei formation in vacuum and dense environments

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Hadronisation is the complex process through which hadrons form from partons. Given its non-perturbative nature, an exact theoretical description is unavailable, necessitating phenomenological assumptions.

In the first part of my presentation, I will discuss novel observables that differentiate between models with distinct hadronisation mechanisms and examine current models limitations. Specifically, I will discuss how correlations between $\phi$ mesons and (multi-)strange hadrons are able to distinguish between EPOS 4 and PYTHIA 8.3 predictions. EPOS 4 is based on core-corona separation between a vacuum phase and a QGP phase, while PYTHIA 8.3 relies on microscopic interactions between Lund strings.

Next, I will present a comprehensive tuning of the PYTHIA 8.3 rope-hadronisation model using the Professor tool. This reveals that simultaneous reproduction of strange and non-strange light-flavour hadrons is not possible. This indicates significant model limitations that have also consequences on the modelling of heavy-flavour yields.

Finally, I will focus on deuteron and Helium-3 formation in PYTHIA 8.3, a process occurring after the hadronisation. Light-nuclei formation is crucial for dark matter searches and cosmic ray interactions in our galaxy. I will present novel predictions for He-3 formation probabilities within and outside jets, using nuclear reactions with parameterised, energy-dependent cross sections tuned to data.

**Category**:

Theory

**Collaboration**:

**Poster Session / 113**

# Conductivity of quark-gluon plasma from charged particles and photons

**Author:** Nicholas Benoit[1]

**Co-authors:** Azumi Sakai ; Chiho Nonaka ; Hiroyuki Takahashi [2]; Takahiro Miyoshi [3]

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Heavy-ion collisions have been used to study quark-gluon plasma (QGP) and can be used to study strong electromagnetic (EM) fields. Because the EM fields penetrate the QGP medium, their evolutions are coupled together. In turn, probes like the flow of direct photons and charged particles will be modified by the coupling [1, 2]. Usually, the EM field modifications are considered separately from the evolution of the QGP. Instead, we model the dynamic evolution of the QGP and EM fields together using relativistic resistive magneto-hydrodynamics (RRMHD) [3]. Our RRMHD model is unique for heavy-ion collisions because it includes a finite scalar electrical conductivity. That conductivity acts as dissipation between the EM fields and the QGP. We demonstrate how the charged particle directed flow (v1) could also be used as an observable for QGP conductivity. Additionally, we apply the same model to calculate a potentially cleaner observable, the direct photon elliptic flow (v2). Because the QGP and EM fields are connected through the same conductivity for both calculations, we will compare and discuss the preferred values of both.
[1] Sun and Yan, Phys. Rev.C 109, 034917 (2024).
[2] Gursoy, Kharzeev, and Rajagopal, Phys. Rev.C 89, 054905 (2014),
[3] Nakamura, Miyoshi, Nonaka, and Takahashi, Phys.Rev.C 107, 014901 (2023).
Nakamura, Miyoshi, Nonaka, and Takahashi, Eur.Phys. J.C 83, 229 (2023).
Nakamura, Miyoshi, Nonaka, and Takahashi, Phys.Rev.C 107, 034912 (2023).

**Category**:

Theory

**Collaboration**:

**Poster Session** / **114**

# Jet Azimuthal Anisotropies from RHIC to LHC

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Azimuthal anisotropies of energetic particles produced in heavy-ion collisions are understood as an effect of a geometrical selection bias due to energy loss. In the measured ensemble, particles oriented in the direction in which the medium is shorter are over-represented as compared to those oriented in the direction in which the medium is longer. In this work we present the first semi-analytical predictions, including propagation through a realistic, hydrodynamical background, of the azimuthal anisotropies for jets, obtaining quantitative agreement with available experimental data.

Jets are multi-partonic, extended objects and their energy loss is sensitive to substructure fluctuations. The ability of the medium to resolve those partonic fluctuations is determined by the physics of color coherence. We find that jet azimuthal anisotropies have a specially strong dependence on coherence physics due to the marked length-dependence of the critical angle $\theta_c$. By combining our predictions for the collision systems and center of mass energies studied at RHIC and the LHC, we show that the relative size of jet azimuthal anisotropies for jets with different cone-sizes $R$ follows a universal trend that indicates a transition from a coherent regime of jet quenching to a decoherent regime. These results suggest a way forward to experimentally reveal the role played by the physics of jet color decoherence in probing deconfined QCD matter.

Mehtar-Tani et al., arXiv: 2402.07869

**Category**:

Theory

**Collaboration**:

**Poster Session** / **115**

# Medium induced shower in an expanding QCD plasma

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Due to multiple scattering with the medium, hard partons can be driven slightly off-shell leading to medium-induced radiation. The BMDPS-Z framework [1], developed within the light cone path integral formalism, has been instrumental in obtaining the medium-induced radiation spectra. This framework was reformulated by Caron-Huot and Gale [2] into a radiation rate and solved numerically for finite medium length with constant temperature.
While these splitting rates can be used to resum multiple successive radiation, the literature has

typically relied on approximations to the radiation rate. This includes either using radiation rats in a medium of infinite length, which overestimates the rates, or approximations to the rates in a medium of finite length that are only valid in different limits of the phase-space. We present an extension of the framework to the case of an expanding medium and employ the resulting rate to resum multiple radiation, which allows us to follow the full medium-induced shower of hard partons in an expanding QCD plasma.

[1] B. G. Zakharov, JETP Lett. 63 952 (1996).
B. G. Zakharov, JETP Lett. 65, 615 (1997).
R. Baier, Y. L. Dokshitzer, A. H. Mueller, S. Peigne and D. Schiff, Nucl. Phys. B 478, 577 (1996) ; 483, 291 (1997).
[2] S. Caron-Huot and C. Gale, Phys.Rev.C 82 (2010) 064902

**Category**:

Theory

**Collaboration**:

**Poster Session / 121**

## Jet-induced hydro response estimation with Flow-model based Generative neural network in heavy-ion collisions

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In high-energy heavy-ion collisions, jets traverse the quark-gluon plasma (QGP) and deposit energy into the medium, leading to jet-induced medium response. The medium response takes the form of Mach-cone-like excitations and can modify the internal structure of the jet, affecting many observables, such as jet shape and jet fragmentation function and so on. However, simulating jet-induced medium response requires not only a complete model that can accurately describe the evolution of hard and soft partons concurrently but also substantial computational resources for full-scale simulations. In this study, we trained a generative neural network using a flow model with gamma-jet events from 0-10% centrality Pb+Pb collisions at 5.02 TeV to estimate the final state effects of jet-induced medium response. Our findings indicate that with only the initial jet information—namely, the energy-momentum of gamma and the jet, along with their initial positions—the network can accurately predict the positions of the Mach-cone's leading edge and maintain a particle spectrum within the same order of magnitude as the actual data.

**Category**:

Theory

**Collaboration**:

**Poster Session / 122**

## Integrating Energy Flow Networks with Jet Substructure Observables for Enhanced Jet Quenching Studies

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The phenomena of Jet Quenching, a key signature of the Quark-Gluon Plasma (QGP) formed in Heavy-Ion (HI) collisions, provides a window of insight into the properties of this primordial liquid. In this study, we rigorously evaluate the discriminating power of Energy Flow Networks (EFNs), enhanced with substructure observables, in distinguishing between jets stemming from proton-proton (pp) and jets stemming from HI collisions. This work is yet another step towards separating significantly quenched jets from relatively unmodified ones on a per-jet basis, which would enable increasingly more precise measurements of QGP properties. We have analyzed simple Energy Flow Networks (EFNs) and subsequently augmented them with global features such as N-Subjettiness observables and Energy Flow Polynomials (EFPs). Our primary objective is to gauge the power of these approaches in the context of Jet Quenching. Initial evaluations using Linear Discriminant Analysis (LDA) set a performance baseline, which is further enhanced through simple Deep Neural Networks (DNNs), capable of capturing non-linear relations in the data. Integrating EFPs and N-Subjettiness observables into EFNs results in the most performant model over this task, achieving state-of-the-art ROC AUC values of approximately 0.84, a very considerable value given that both medium response and underlying event contamination effects are taken into account.

**Category**:

Theory

**Collaboration**:

**Poster Session / 123**

## Open heavy-flavour and quarkonium measurements with the forthcoming NA60+ experiment

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The NA60+ experiment, proposed for data taking from 2029, aims at studying the high $\mu_{\rm B}$ region of the QCD phase space diagram. It will make use of the high intensity of CERN SPS beams, and detect rare probes via a beam-energy scan with Pb-Pb and p-A collisions in the interval $6.3 < \sqrt{s_{\rm NN}} < 17.3$ GeV.

In this talk, we will focus on the prospects for measurements of hidden and open charm. Open charm hadrons will be detected through their hadronic decays, reconstructing tracks in the silicon detectors of the vertex telescope. High-precision measurements of the yield of $D_0$, $D^+$, and $D_{\rm s}$ mesons, and of $\Lambda_{\rm c}$ baryons, will allow us to constrain the transport properties of the QGP and the features of heavy-quark hadronisation.

Charmonium states will be accessed through their dimuon decay, matching muon tracks reconstructed in the vertex telescope and in the muon spectrometer. The J/$\psi$ and $\psi$(2S) measurements at various collision energies will allow us to identify the onset of charmonium suppression in a deconfined medium, correlating this observation with the temperature of the system, measured in the same experiment via thermal dimuons.

Finally, we will discuss the competitiveness and complementarity of NA60+ in the landscape of the experiments foreseen at other facilities in the next decade.

**Category**:

Experiment

**Collaboration**:

NA60+ collaboration

**Poster Session** / **124**

## Bottomonium production measurements at LHCb

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Bottomonium production is sensitive to both the structure of nucleons and the interactions of b quarks with the nuclear media produced in heavy-ion collisions. The LHCb detector's forward geometry allows for studying bottomonium production in a unique kinematic regime. Recent LHCb studies of bottomonium production will be presented, including measurements sensitive to final-state effects in small collision systems and studies of multi-parton interactions

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session** / **126**

## Recent studies of open charm production at LHCb

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Open charm production is a sensitive probe of both hot and cold nuclear matter effects. Charm meson production provides strong constraints on nuclear parton distributions, while charm baryon and strange charm hadron production can be used to probe strangeness- and baryon-enhancing hot QCD effects, respectively. The LHCb detector is designed to study heavy flavor hadrons at the LHC, providing unique opportunities to study open charm production in heavy ion collisions. In this contribution, recent LHCb results on open charm production will be discussed, as well as their comparisons with recent theoretical models.

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session** / **127**

## Flow and correlation measurements at LHCb

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Particle correlations are powerful tools for studying quantum chromodynamics in hadron collisions. In heavy-ion collisions, azimuthal angular correlations probe collective phenomena in hot, dense, nuclear media, such as QGP. Angular correlations in small collision systems could point to QGP production or potential initial-state correlations. The LHCb experiment has the unique ability to study particle correlations in high-energy hadron collisions at forward rapidity,
complementing the results from other experiments. In this contribution, recent results on collective flow from the LHCb experiment will be discussed

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session** / **129**

## The measurement of Drell-S$\ddot{o}$ding process through exclusive $\pi^+\pi^-$ pair photoproduction in ulrtraperipheral Au+Au collisions at 200 GeV

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The Drell-Soding process, non-resonance pair production through photon-nuclear interaction plays a vital role in the exclusive $\pi^+\pi^-$ pair mass profile description. Among the products of photon-nuclear interactions, the continuum $\pi^+\pi^-$ pairs are directly produced in addition to decays of photoproduced $\rho^0$. Previous measurements and the widely utilized Monte Carlo model (STARlight) have treated the non-resonance $\pi^+\pi^-$ production as invariant across the $\rho^0$ mass region, with corrections applied generally independent on the transverse momenta of $\pi^+\pi^-$ pairs. Leveraging theoretical model calculations, we have identified the mass slope in the $\rho^0$ mass region for the Drell-Soding process, and measured the differential cross-section of this process as a function of $p_T$, rapidity and mass. This novel approach not only refines our understanding of the underlying dynamics of photon nuclear scattering but also serves as another probe for the nuclear profile.

In this talk, we will present the first measurement of the Drell-Soding process in ultra-peripheral Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV from the STAR experiment. We will report the measurement of the interference angular modulation and the t spectrum of the Drell-Soding $\pi^+\pi^-$ production. We will discuss the implications of mass and lifetime of a virtual particle anti-particle pair, fluctuated from a photon in the photon nuclear interactions.

**Category**:

Experiment

**Collaboration**:

STAR

**Poster Session** / **133**

## Studies of nucleon structure at LHCb

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The LHCb detector's forward geometry provides unprecedented access to the very low regions of Bjorken x inside the nucleon. LHCb is able to study charged and neutral light hadron production, as well as relatively rare probes such as heavy quark. These data provide unique constraints on nuclear parton distributions. This contribution will discuss recent LHCb measurements sensitive to the low-x structure of nucleons, and discuss the impact of recent LHCb measurements on global analyses of nuclear parton distributions

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session** / **136**

## SMOG2: a high-density gas target at the LHCb experiment

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In preparation to the LHC Run3, the LHCb gaseous fixed-target, SMOG, was upgraded to offer higher instantaneous luminosity by up to two orders of magnitude with respect to Run2, new gases, including non-noble ones such as hydrogen, and an increased experimental accuracy. Since 2022, LHCb is working with two independent collision points and as a collider and a fixed-target experiment simultaneously, a unique opportunity in the scientific panorama. In

this contribution, the performance of the system from the 2024 acquired data, the first obtained results and the physics prospects for the incoming years will be presented.

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session / 138**

## New toy model simulation for elucidating the parton energy loss mechanism depending on path-length within the quark-gluon plasma medium

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The purpose of this study is to elucidate the parton energy loss mechanism depending on path-length within the quark-gluon plasma (QGP) medium. In relativistic heavy ion collision experiments, it is difficult to directly observe the QGP because of its short life time and small size. Detecting a high momentum parton which passes through the QGP provide information of the QGP properties via the energy loss of the parton. The parton is detected as a jet and the parton energy loss is measured as the jet suppression. In general, there are two ways of measuring the jet suppression: the jet nuclear modification factor ($R_{\mathrm{AA}}^{\mathrm{jet}}$) and the jet emission azimuthal anisotropy ($v_2^{\mathrm{jet}}$). Each independent measurement of the $R_{\mathrm{AA}}^{\mathrm{jet}}$ or $v_2^{\mathrm{jet}}$ has not clarified the parton energy loss mechanism.
Thus, we devised and developed a new simulation with parton energy loss models ($\Delta E = CL^n$), which the $C$ is an arbitrary coefficient, the $L$ is the path-length, and the $n$ is a model dependent parameter. In this simulation, using the measured jet yield $p_{\mathrm{T}}$ distributions as input, it can provide the $R_{\mathrm{AA}}^{\mathrm{jet}}$ or $v_2^{\mathrm{jet}}$ and quantify the $C$ and $L$.
In this presentation, we will show the comparison of the simulation results with the measured results by the LHC-ALICE experiment and the values of the $C$ and $L$ determined by this simulation.

**Category**:

Experiment

**Collaboration**:

**Poster Session / 141**

## Strangeness studies in LHCb heavy-ion collisions

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Strange hadron production provides information about the hadronization process in high-energy hadron collisions. Strangeness enhancement has been interpreted as a signature of quark-gluon plasma formation in heavy-ion collisions, and recent observations of strangeness enhancement in small collisions systems have challenged conventional hadronization models. With its forward geometry and excellent particle identification capabilities, the LHCb detector is well-suited to study strangeness production in a unique kinematic region. Recent studies of strangeness production with the LHCb detector will be presented, including measurements of strangeness enhancement in the charm- and beauty-hadron systems

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session / 144**

## Observation of top-quark pair production in heavy-ion collisions in the ATLAS experiment

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Top quarks, the heaviest elementary particles carrying colour charges, are considered to be attractive candidates for probing the quark-gluon plasma pro- duced in relativistic lead-lead collisions. In proton-lead collisions, top-quark production is expected to be sensitive to nuclear modifications of parton distri- bution functions at high Bjorken-x values. In Run 2, the ATLAS experiment recorded 165 nb−1 of proton-lead data and 1.9 nb−1 of lead-lead data at centre- of-mass energy of 8.16 TeV and 5.02 TeV per nucleon pair, respectively. In this poster, we present the final measurement of the top-quark pair production in dilepton and lepton+jet decay modes in the proton-lead system with the ATLAS detector. The precision of the analysis requires detailed performance studies involving electrons, muons, jets and b-quark jets. A profile-likelihood approach is used to extract signal significance. The nuclear modification factor is also measured. The results are compared to theory predictions involving state-of- the-art nuclear parton distribution functions. Prospects for the top-quark pair measurement in lead-lead collisions are also presented.

**Category**:

Experiment

**Collaboration**:

ATLAS

**Poster Session / 160**

## Helium identification and production at LHCb

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In this contribution, recent results for helium identification and production at LHCb will be discussed. From √sNN = 13 TeV pp collisions, a nearly background-free sample of more than 105 helium candidates is identified by their ionisation losses in the silicon detectors, combined with information from the calorimeter, the muon chambers and the RICH detector. Combined with the excellent LHCb vertexing capabilities, (anti)helium production from (anti)hypertriton or (anti)Lambda-b decays is studied. In both cases, a rich programme of QCD and astrophysics interest, exemplifying LHCb flexibility in exploring new research fields, is foreseen.

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session** / **165**

## Study of modified near-side jet peak structure in a longitudinally boosted flowing medium in PbPb collisions with CMS

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In two-particle angular correlation measurements, jets give rise to a near-side peak formed by particles associated with a higher $p_{\mathrm{T}}$ trigger particle. Measurements of these correlations as a function of pseudorapidity and azimuthal differences are used to extract the centrality and $p_{\mathrm{T}}$ dependence of the shape of the near-side peak in the $p_{\mathrm{T}}$ range $3 < p_{\mathrm{T,\,trig}} < 16$ GeV and $1.5 < p_{\mathrm{T,\,asso}} < 8$ GeV in lead-lead (PbPb) and proton-proton collisions at $\sqrt{s_{\mathrm{NN}}}$= 5.02 TeV. A combined fit of the near-side peak and long-range correlations is applied to the data. By disentangling short-range correlations from long-range contributions, we quantify the variance of the near-side peak, which exhibits significant broadening in the longitudinal direction from peripheral to central PbPb collisions, particularly pronounced for low-$p_{\mathrm{T}}particles.Thisbroadeningphenomenondiminishesabove$p_\mathrm{T} = 4$GeV.Incontrast,thewidthofthepeakintheazimuthaldirectionremainsnearlyconstantacrosscentrality.Addition sidepeak,whichincreasestowardsforwardrapiditycomparedtomidrapidity,attributedtojet−mediuminteractionsinPbPbcollisions.Thisrapidityasymmetryphenomenonismorepronouncedinthehigh$p_\math $-16.0GeV,andlow$p_\mathrm{T,\,asso}$ between 1.5–4.0 GeV.

**Category**:

Experiment

**Collaboration**:

CMS

**Poster Session** / **169**

## Studying the interplay of medium effects on heavy quarks and quarkonia using high-precision charmonium measurements in PbPb collisions with CMS

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Charmonia, such as the J/$\psi$ and $\psi$(2S) mesons, are important probes of the quark-gluon plasma (QGP). The measurement of their nuclear modification factor, elliptic and triangular flow can provide strong constraints for the mechanism of in-medium energy loss. In this talk, results on the relative J/$\psi$ and $\psi$(2S) modification, based on the pp and PbPb data collected at $\sqrt{s)_{NN}}$ = 5.02 TeV by CMS, will be reported. Also we present the second-order and third-order Fourier coefficients, $v_2$ and $v_3$ for prompt and nonprompt J/$\psi$ and prompt $\psi$(2S) mesons. In addition, the nuclear modification factor of charmonia in PbPb collisions will be reported.

**Category**:

Experiment

**Collaboration**:

CMS

**Poster Session / 183**

## Modification of jets travelling through a brick-like medium

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The present work addresses the puzzle related to the observation of collective flow in collisions of small systems (which indicates the presence of a medium even in such collisions) and the absence of jet quenching in such systems (which would not be expected if jets are traversing a medium). This study has been done using the JEWEL event generator with a "brick"-like medium. This simplified medium is made up of a collection of gluons at a given temperature and density distributed in an elliptical or spherical volume. A pair of jets is then created in the center of this medium and, as the jets evolve, the number of jet-medium interactions is counted. This way, we were able to study how $R_{AA}$ and $v_2$ vary with the number of jet-medium interactions independently from any models for medium expansion and evolution.

What we have found is that, for different eccentricities of an ellipsoidal medium, a $v_2$ signal can be obtained with a smaller number of jet-medium interactions than are necessary to obtain a signal in $R_{AA}$. This indicates that, if there is a medium being created in collisions of small systems, it is possible that the volume of such a medium is large enough for the creation of collective flow but not large enough to give rise to an $R_{AA}$ signal. A paper containing these results is in preparation and will soon be published on Arxiv and submitted to a journal for peer review.

**Category**:

Theory

**Collaboration**:

**Poster Session / 186**

# Jet spectra evolution as a function of center of mass energy in pp collisions with ALICE

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Jets are produced by highly virtual quarks and gluons that emerge from initial hard scattering processes and are an important probe of the QCD evolution of the collision. Jet measurements in small systems such as pp are important in order to provide constraints on the parton distribution functions (PDFs) of the proton and the strong coupling constant $\alpha_s$. They also test pQCD calculations and the fragmentation of partons into hadrons. They can also be used as a reference for more complex systems, such as p–Pb and Pb–Pb collisions, where cold nuclear matter effects and a strongly-interacting medium play a role. While jet cross-section measurements provide a test for pQCD calculations and also help to constrain QCD-based MC models, jet cross-section ratios are very good tools to test the inner structure of jets. Measuring jet cross-section ratios at different jet resolution parameters and at different center of mass energies tests the universalities of fragmentation functions. In this poster we present jet cross-section measurements at different jet resolution and collision centre-of-mass energies. This work extends previous jet studies at ALICE by taking a first look at the high statistics and precision measurements of fully reconstructed jets (full jets reconstructed from charged-particle tracks and neutral constituents) with Run 3 data.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session / 199**

# Investigating high-$p_T$ azimuthal anisotropies in small systems using T-odd parton distribution functions

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Experimental observations have measured finite azimuthal anisotropies in small systems produced in pp and pA collisions, even at large pT which may imply the formation of a Quark-Gluon Plasma. In heavy-ion collisions, high-pT azimuthal anisotropies are understood to be generated by the path-length dependent energy loss. However, in small systems, even if a QGP is formed, the medium is so small and short lived that jet-medium interactions are negligible, and no medium modification of the spectrum has been observed.
We present an explanation for the high-pT azimuthal anisotropies, without any nuclear modification of the angle integrated high-pT spectra, using transverse momentum dependent parton distribution functions and fragmentation functions [1]. The presence of transverse momentum allows for the inclusion of T-odd processes with transversely polarized quarks or linearly polarized gluons from

unpolarized protons, known as the Boer-Mulders' effect. Due to the correlation between the spin or polarization of partons and their transverse momentum, relative to the proton, large azimuthal anisotropies are generated in the final state. These correlations can simultaneously explain the small azimuthal anisotropies at high-pT in pp collisions and the somewhat larger anisotropies in pA collisions, where, due to initial state effects, the intrinsic transverse momentum of the partons is enhanced by a factor of $A^{1/3}$.
[1] I. Soudi, A. Majumder, arXiv: 2308.14702, 2404.05287

**Category**:

Theory

**Collaboration**:

**Poster Session** / **200**

## First $D^0$-tagged jet axes difference measurement in pp collisions at $\sqrt{s} = 5.02$ TeV with ALICE

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Substructure measurements of jets containing heavy-flavor hadrons play an important role in testing pQCD calculations in proton-proton (pp) collisions and are critical tools for studying the quark-gluon plasma (QGP) created in heavy-ion collisions. We study three different $D^0$-tagged jet axis definitions with varying degrees of sensitivity to wide-angle radiation: Standard, Soft Drop groomed (SD), and Winner-Take-All (WTA). By considering the angular difference between different axes at relatively low jet momentum, we can study the radiation pattern inside the reconstructed jets and provide insight into the associated charm-quark fragmentation and hadronization processes. We present the first $D^0$-tagged jet axes difference studies carried out in pp collisions at $\sqrt{s} = 5.02$ TeV with the ALICE experiment at the LHC, for jets of transverse momentum $p_{\mathrm{T,jet}} > 5$ GeV/$c$ and $D^0$ mesons with $p_{\mathrm{T,D^0}} > 2$ GeV/$c$. The measurements of the radial distributions of $D^0$ mesons with respect to the jet axis, $\Delta R_{\mathrm{D,jet}}$, is reported. We also study the opening angle, $\Delta R_{\mathrm{axis}}$, between various definitions for the axis of a $D^0$-tagged jet. These measurements will serve as important groundwork for an in-depth understanding of charm-quark diffusion in the QGP.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **211**

## X-SCAPE as a universal Event Generator for e+p, e+e- and pp collisions

**Authors:** JETSCAPE Collaboration[None]; Rainer Fries[1]

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In this talk we discuss using the X-SCAPE Monte Carlo event generator and Hybrid Hadronization to simulate particle production in a large variety of collision systems. New capabilities have been

added to X-SCAPE to calculate deep inelastic scattering in $e + p$ collisions. Hybrid Hadronization combines quark recombination, applicable when distances between partons in phase space are small, and string fragmentation appropriate for dilute parton systems. It can therefore smoothly describe the transition from very dilute parton systems like $e^+ + e^-$ and $e + p$ to full $A + A$ collisions. Here we present the results from tuning X-SCAPE to $e^+ + e^-$ and $p+p$ collisions. We include hadron, jet, and global event observables from the ALEPH, PHENIX, STAR, ALICE, and CMS collaborations. We also present first results from $e + p$ calculations compared to H1 and ZEUS data to validate X-SCAPE as an event generator for deep inelastic scattering.

**Category**:

Theory

**Collaboration**:

JETSCAPE

**Poster Session** / **213**

## Imaging the Jet-Induced Medium Response with Energy Correlators

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In heavy-ion collisions, jets formed from hard-scattered partons experience an overall energy loss and have a modified internal structure compared to vacuum jets. These modifications are a result of the interactions between the energetic partons in a jet shower and the strongly coupled quark-gluon plasma (QGP). As the jet traverses the QGP, it loses momentum to the medium, which in turn responds to the presence of the jet. This "medium response"modifies the momentum distribution of the (soft) hadrons produced when the QGP freezes out. Since these hadrons carry the momentum lost by the parton shower, they and the modified shower both contribute to the energy flow in jets. The quantitative description of the medium response is an open question under active investigation. Recently, the projected N-point energy correlators (ENCs) have seen a resurgence of interest to probe vacuum QCD. For the first time, we will present a computation of the full three point energy-energy-energy correlation function in heavy-ion collisions and demonstrate its use for studying the shape of the energy flow originating from medium response. For this study, we utilize the Hybrid Model that implements a hydrodynamical medium response via the wake. We will show that measuring three-point correlation functions offer a promising experimental avenue for imaging the wake of the jet as when the three angles are well-separated the three-point correlator is dominated by the medium response.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **216**

# Low-mass, low-momentum virtual photon measurements with HADES at SIS18

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Collisions of heavy nuclei at relativistic energies generate a hot and dense medium, whose microscopic properties can be studied with electromagnetic probes.
Dileptons serve as a unique tool because they do not interact strongly with the surrounding matter and carry undisturbed information about the QCD matter produced in the reaction.
By examining low-mass and low-momentum dileptons, we can gain insights into transport properties and even new phases of QCD matter, such as the color superconductive phase.

In this contribution, we discuss the essential steps towards investigating soft dileptons in the low-mass, low-momentum phase-space.

To achieve this, data from Ag+Ag collisions at 1.23 AGeV with a nominal magnetic field intensity were analyzed as a reference and compared with a special run conducted with a reduced magnetic field (5% of $B_{max}$) to increase the acceptance of low-momentum pairs.

Additionally, we will present predictions from simulations regarding the phase-space coverage at reduced magnetic field intensity and provide a preview of the upcoming low-magnetic field run with Au+Au collisions at 0.8 AGeV with the HADES experiment.

**Category**:

Experiment

**Collaboration**:

HADES

**Poster Session / 218**

# Exploring the universality of jet quenching via Bayesian inference

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Experimental data on a wide range of jet observables measured in heavy ion collisions provide a rich picture of the modification of jets as perturbative probes and of the properties of the created quark-gluon plasma. However, their interpretation is often limited by the assumptions of specific quenching models, and it remains a challenge to establish model-independent statements about the universality in different jet quenching observables.

In this work, we propose a treatment that is agnostic to the details of the jet-medium interactions and relies only on the factorization picture of QCD. Bayesian inference is used to learn the quark- and gluon-jet quenching directly from experimental data of inclusive jet observables. Evidence of the universality of jet quenching is provided by validating the learned jet energy loss through the prediction of photon-tagged jet measurements, for which the quark/gluon fraction differs from that in inclusive jets, across momenta. The extracted posterior distributions can then serve to retrieve

theoretical insight in a data-driven way, and can be employed to constrain theoretical models for jet quenching.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **221**

## Thermalization and Hydrodynamization in Small and Large Systems

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The early time dynamic which connects the far-from-equilibrium matter created after the high energy collision toward the hydrodynamic regime is still a poorly understood process. We constructed a parton cascade model based on the hadronic transport model SMASH in order to explore this phase since SMASH has been shown to be able to correctly simulate multiparticle interaction in the hadronic case. We included 2-to-3 partonic interactions as the main source of particle and entropy production which are important for thermal and chemical equilibration. The initial condition for large and small collision systems are prepared using mini-jet model. Focusing on the mid-rapidity region $|\eta| < 0.5$ and up until time = 5 fm, we assume that perturbation QCD is still valid at a relatively lower energy region even at a later time and fixed the QCD coupling constant to a small value. Chemical and thermal equilibrium is assumed when the ensemble follows the Maxwell-Boltzmann distribution. In our model, hydrodynamization is measured by Knudsen number with the characteristic length of the medium calculated using a clustering algorithm based on the spatial information of the particles. We use the time evolution of these values in high energy Pb-Pb collision systems to establish a benchmark and compare it with p-p at 13 TeV to predict whether hydrodynamization and thermalization occur and identify the timescale of each process.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **225**

## Decoding the composition of QCD matter with the polarization of thermal dileptons

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**Co-authors:** Bengt Friman [1]; Enrico Speranza [2]; Hendrik van Hees ; Jochen Wambach [3]; Ralf Rapp ; Tetyana Galatyuk

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Multi-differential measurements of dilepton spectra serve as a unique tool to characterize the properties of matter in the interior of the hot and dense fireball. An important property of virtual photons is their spin polarization defined in the rest frame of the virtual photon for a chosen quantization axis. While the total yield and observable spectra are proportional to the sum of the longitudinal and transverse components of the spectral function, the polarization depends on their difference. As the processes that drive the medium effects in the spectral function change with invariant mass and momentum, this becomes a powerful tool for studying the medium composition.
In this contribution, the polarization observables of thermal virtual photons as a function of mass and momentum will be presented. To connect to the experiment, we discuss the modeling of the underlying medium evolution of heavy-ion collisions in the few GeV energy regime via coarse-grained transport simulations. The polarization results obtained within our framework are compared to existing measurements from HADES and NA60, and predictions for upcoming HADES data will be provided. Finally, we address the prospects of using dilepton polarization to disentangle the contributions of hadronic and partonic origin to thermal radiation.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **226**

# Dimuon measurement in low and intermediate mass region in √s = 13.6 TeV pp collisions at ALICE

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In high-energy proton-proton (pp) collisions, the study of dimuon production provides crucial insights into particle production mechanisms and can serve as a baseline for the study of the properties of the quark-gluon plasma (QGP). In particular, the low (below the phi mass) and intermediate (between the phi and the J/psi) invariant mass regions are of interest for measurements of vector mesons (rho, omega, phi) and open heavy flavors. Signals of chiral symmetry restoration and thermal dimuons may be detected on top of the previous sources, in nuclear collisions.

The ALICE experiment has been collecting pp collisions data at √s = 13.6 TeV in the ongoing LHC Run 3. In this study, we analyze data from the muon spectrometer, which has been upgraded by the installation of the Muon Forward Tracker.

Data have been analyzed to extract the dimuon invariant mass spectra. The combinatorial background was then evaluated with a data-driven procedure while correlated background sources were estimated by a MonteCarlo-based procedure. The specific goal of this study is to measure the production cross-section of heavy quarks, and first results of the analysis will be presented.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **229**

# Underlying event characterization in 200 GeV Au+Au collisions for jet measurements with the sPHENIX detector

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sPHENIX is a new experiment at the Relativistic Heavy Ion Collider (RHIC), designed with large-acceptance, hermetic EM and hadronic calorimeters to enable qualitatively new measurements of jet probes of the QGP at RHIC. Since jets in heavy ion collisions sit on top of large fluctuating backgrounds, these must be understood to carry out a precision program of jet physics. This talk reports a detailed characterization of the underlying event and jet background fluctuations at RHIC, as well as direct comparisons of the fluctuations resulting from methods typically used by different heavy ion experiments, using 200 GeV Au+Au collision data collected with the sPHENIX calorimeter system during its 2023 commissioning run. The characterization uses a multi-faceted approach, including unbiased sampling of calorimeter window areas and random cones, as well as methods sensitive to jet reconstruction effects such as embedding high-$p_T$ probes from data or simulation into recorded minimum-bias Au+Au data. The non-Poissionian background fluctuations for several jet background subtraction methods envisioned for use in sPHENIX are also investigated. Finally, we discuss the sPHENIX physics enabled by rigorous description of these backgrounds.

**Category**:

Experiment

**Collaboration**:

sPHENIX

**Poster Session** / **233**

# Beam test results for the new prototype ITS3 sensor design

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The ITS3 is the future upgrade for the ALICE Inner Tracking System for Run 4 of the LHC. It replaces the three innermost layers with a truly cylindrical design of bent and stitched MAPS sensors, along with material budget as low as 0.07% $X_0$ per layer and less than 40 mW/cm$^2$ power consumption. These improvements increase the pointing resolution by a factor of two, and tracking efficiency by up to 30% at transverse momenta less than 300 MeV/$c$, and allow for operation of the innermost layer at 19 mm away from the LHC beam pipe. MOnolithic Stitched Sensor evaluation circuits have been produced in two variants, one 27 cm long (MOSS) and one 2.2 cm long (babyMOSS). This poster reports on recent test beam campaigns using babyMOSS sensors to quantify their performance metrics such as tracking efficiency, fake hit rate, and spatial resolution.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **238**

## Exploring hadronization with heavy-flavor jets with LHCb

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Understanding the nonperturbative process of hadronization is a persistent goal in experimental studies of QCD. Since heavy quark production is suppressed at the hadronization scale, heavy-flavor hadrons offer a high-precision probe of the connection between theoretical calculations and experimental final states. Jets containing different flavors of these heavy hadrons, reconstructed across a broad range of jet transverse momentum, explore the dependence of local hadronic formation at different partonic mass scales with distinct final states. Furthermore, quarkonia production in jets explores the intersection between the parton shower, where gluons split into heavy quark-antiquark pairs, and the production of closed heavy-flavor hadrons. Jet substructure can also be used to probe the formation of exotic hadrons, whose structure is still not well understood. This talk presents recent studies of hadronization using heavy-flavor jets detected with the LHCb detector. These studies include inclusive hadron production in heavy-flavor jets, as well as quarkonia and tetraquark production in jets. Results are compared to various models of hadronization,providing strong new constraints on theoretical predictions of confinement in jets.

**Category**:

Experiment

**Collaboration**:

LHCb

**Poster Session** / **239**

## Measuring thermal dimuons at high baryochemical potential with the NA60+ experiment at the CERN SPS

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The high-intensity beams provided by the CERN SPS in a wide energy interval offer a unique opportunity to investigate the QCD phase diagram at high baryochemical potential $\mu_B$. The NA60+ experiment, proposed for taking data with heavy-ion collisions at the SPS in the next years, has a strong potential for investigating the QCD phase diagram via measurements of electromagnetic probes in a beam-energy scan of Pb-Pb and p-A collisions in the interval $\sqrt{s_{NN}}$ = 6-17 GeV.
In this talk the physics program of the NA60+ experiment on thermal dimuons will be described. At beam energies below top SPS energy, the baryon density becomes maximal and its effect on ρ meson broadening can be measured by NA60+ with utmost precision.

NA60+ will have sensitivity to the ρ–$a_1$ chiral mixing mechanism, which provides access also to the properties of the $a_1$ by exploring the thermal dimuon mass spectrum in the range 1 < M < 1.4 GeV. For dimuon masses above 1.5 GeV, the temperature of the emitting source can be directly extracted by a fit of the mass spectrum. The experimental program of NA60+ plans to determine for the first time a caloric curve by measuring the temperature vs beam energy, with particular focus on $\sqrt{s}_{NN}$ < 10 GeV, which is believed to be essential to map out the phase transition regime at high $\mu_B$. Finally, the competitiveness and complementarity of NA60+ in the landscape of the experiments foreseen at other facilities in the next decade will be discussed.

**Category**:

Experiment

**Collaboration**:

NA60+

**Poster Session** / **241**

## Intelligent experiments through real-time AI: Fast Data Processing and Autonomous Detector Control for sPHENIX and future EIC detectors

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A collaboration of scientists from LANL, MIT, FNAL, NJIT, ORNL, and GIT, supported by the DOE Office of Science Nuclear Physics AI Machine Learning initiative, is exploring advanced AI technologies to tackle data processing challenges at RHIC and the future EIC. The main objective is to develop a demonstrator for real-time processing of high-rate data streams from sPHENIX experiment tracking detectors to identify rare heavy-flavor events in proton-proton (p+p) collisions. Our innovative approach integrates streaming readout with an intelligent control system, utilizing FPGA hardware to accelerate AI inference. This improves the efficiency of collecting rare heavy-flavor events in high-rate p+p collisions (˜1 MHz), optimizing the use of limited DAQ bandwidth (˜15 kHz). We employ Graph Neural Network-trigger algorithms, trained on sPHENIX p+p collision simulation data, and use the hls4ml package to convert AI models into firmware. These real-time AI technologies are deployed on FELIX-712 boards equipped with Xilinx Kintex Ultrascale FPGAs. Our approach is also adaptable to other fields requiring high-throughput data streams and real-time detector control, including future EIC experiments. This talk will highlight AI-driven heavy-flavor triggering for sPHENIX and the development of DIS electron tagger algorithms for the EIC, showcasing the transformative potential of AI and FPGA technologies in real-time data processing for high-energy nuclear and particle experiments.

**Category**:

Experiment

**Collaboration**:

sPHENIX

**Poster Session** / **246**

# Backreaction of QGP fluids from recoil partons

**Author:** Shoto Sakuma[1]

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Modification of jets is a powerful tool to diagnose a quark gluon plasma (QGP) in high-energy heavy-ion collisions. During propagation of partons in a jet through the QGP medium, constituents of the medium acquire high energy and momentum from them and are kicked out to be non-equilibrated partons. These partons are called the recoil partons. Together with how the jet partons radiate energy and momentum during traversing the medium, the recoil process is also crucial in description of jet modification and in understanding of properties of the QGP in high-energy heavy-ion collisions.

Due to the energy-momentum conservation, the backreaction of the QGP would occur when the partons are kicked out from the QGP medium. To develop a general-purpose event generator which respects the energy-momentum conservation, the recoil process should be implemented as "deposition of negative energy and momentum"into the fluids.

In this study, we introduce the negative source terms in hydrodynamic equations to consider the dynamical evolution of backreaction of the QGP medium in recoil processes. Using this framework, we analyze effects of the backreaction on the jet structure function toward comprehensive understanding of jet propagation in medium.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **260**

# First Measurements of Charged-Particle Jet Production in pp Collisions at \sqrt{s} = 13.6 TeV with ALICE

**Authors:** Beomkyu Kim[1]; Joonsuk Bae[2]

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In 2022, the ALICE Collaboration commenced Run 3 with upgrades to the Inner Tracking System (ITS2) and the Time Projection Chamber (TPC), both pivotal for probing rare phenomena with unprecedented precision. The upgrades to ITS2 enable higher tracking resolution, while the improvements to the TPC allow for continuous readout, significantly boosting data acquisition and resolution. Using these enhancements we present the first measurement in ALICE of the charged-particle jet cross section in pp collisions at $\sqrt{s} = 13.6\,\mathrm{TeV}$ using the anti-$k_{\mathrm{T}}$ algorithm ($R = 0.4$). These results showcase the new jet finding capabilities of the ALICE detector and validate data integrity against prior Run 2 measurements.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **262**

## SUBA-Jet framework for jet and medium production in heavy-ion collisions at high energies

**Authors:** Alexander Lind[1]; Iurii Karpenko[2]; Joerg Aichelin[None]; Josef Bobek[3]; Martin Rohrmoser[4]; Pol-Bernard GOSSIAUX[None]

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We present SUBA-Jet, a newly constructed framework for jet and medium production in heavy-ion collisions at ultra-relativistic energies [1]. The framework is developed in a spirit similar to JETSCAPE, and our aim is to simulate the complete dynamics of heavy-ion collisions, with jet and medium hadron production combined.
The development of a jet starts with a seed parton with high virtuality, currently generated by Pythia 8. The parton splits, thus developing a jet shower. The jet partons experience collisional and radiative energy loss, and the latter is simulated via coherent bremsstrahlung. The coherence is achieved by increasing the phase of the trial gluons through elastic scatterings with the medium. Above a phase threshold, the trial gluon will be realised and can produce coherent radiation themselves.
The evolution of the medium starts from an initial state provided by TrENTo model, with subsequent viscous fluid dynamical expansion, particlization and final-state hadronic scattering and resonance decays via SMASH cascade.
In this talk we present i) construction of the framework and its ingredients, ii) benchmark of the coherent jet energy loss and comparison with BDMPS-Z spectra, and iii) benchmark of jet R_AA in a scenario with realistic production points of the jet hadrons and realistic background medium representing a system formed in Pb-Pb collision at 5.02 TeV LHC energy.

[1] IK, A. Lind, M. Rohrmoser, J. Aichelin, P.-B. Gossiaux, arXiv: 2404.14579 [hep-ph]

**Category**:

Theory

**Collaboration**:

**Poster Session** / **263**

## Investigating virtual photon polarization via $\gamma^* \to \mu\mu$ in Pb-Pb at $\sqrt{s_{NN}} = 2.76$ TeV by numerical calculation

**Author:** Kento Kimura[1]

**Co-authors:** Chiho Nonaka ; Ken-Ichi Ishikawa [2]; Kenta Shigaki [1]; Nicholas Benoit [2]

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The virtual prompt photons are produced at the initial stage of heavy-ion collisions and are sensitive to the extremely strong magnetic field produced in non-central heavy-ion collisions. At LHC energies, this magnetic field can reach intensities of $10^{15}$ - $10^{16}$ T. In the presence of this magnetic field, the dilepton decayed from a virtual photon can be polarized in response to the direction of the magnetic field because the vacuum fermion fluctuation links photons to the magnetic field [1]. We define this phenomenon as the virtual photon polarization and propose the virtual photon polarization as a probe of the magnetic field.

We will present the first numerical calculation results on the intensity of virtual photon polarization in Pb-Pb at $\sqrt{s_{NN}} = 2.76$ TeV, specifically for the decay channel $\gamma^* \to \mu\mu$. These calculations are crucial for evaluating the feasibility of observing this effect with the ALICE experiment. The magnetic field intensity is calculated using magnetohydrodynamics [2], and we have determined the polarization intensity at each time step. This allows us to estimate the inclusive polarization in Pb-Pb collisions.

[1] Ken-Ichi Ishikawa, Daiji Kimura, Kenta Shigaki, Asako Tsuji, Int.J.Mod.Phys.A 28 (2013) 1350100
[2] Nakamura, Miyoshi, Nonaka, and Takahashi, Phys.Rev.C 107, 034912 (2023)

**Category**:

Theory

**Collaboration**:

**Poster Session** / **264**

# HGCROC v2 readout chip characterization and radiation tolerance for FoCal E-pad detector in ALICE

**Authors:** Daito Shibata[1]; Hikaru Kano[2]; Jonghan Park[1]; Ken Oyama[3]; Kento Ariizumi[4]; Mai Takamura[5]; Masato Yokoyama[None]; Maya Shimomura[5]; Mirei Hunaki[4]; Motoi Inaba[1]; Noritaka Orii[2]; Rinpei Hayashida[2]; Shingo Sakai[1]; Subaru Ito[1]; Taichi Inukai[1]; Taiki Kondo[2]; Takahiro Fusayasu[6]; Takashi Hachiya[5]; Tatsuya Chujo[1]; Tomohiro KOBAYASHI[7]; Toshiaki Shibata[8]; Yasunori Osana[9]; Yui Ishigaki[5]; Yuji Goto[10]; Yuka Sasaki[5]; Yuto Hama[2]; Yuto Nishida[2]

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The Forward Calorimeter (FoCal) detector is scheduled for installing in the ALICE experiment for the LHC-Run4 upgrade (2029-2032).
The FoCal consists of the FoCal-E (Electromagnetic Calorimeter) and the FoCal-H (Hadronic Calorimeter). The FoCal-E is a detector based on a Si sensor and tungsten to measure direct photons at forward rapidity.

For the readout, each Si pad hosts the HGCROC2 Application-Specific Integrated Circuit (ASIC) originally developed by the OMEGA group for the CMS High Granularity Calorimeter (HGCal).

The FoCal-E has two subsystems, pad and pixel. The FoCal-E pad detector plans to use about 2,000 PCBs containing Si pads and HGCROC chips.
Therefore, it's very important to evaluate the performance of a large number of HGCROC chips and to understand their variability.

This poster summarizes the characteristics, performance variability, and radiation tolerance of the HGCROC v2 chips.
Furthermore, we will discuss the perspective of HGCROC v3 chip for the final FoCal-E pad production and readout scheme.

**Category**:

Experiment

**Collaboration**:

**Poster Session** / **265**

## Hanbury-Brown-Twiss signature for clustered substructures probing primordial inhomogeneity in hot and dense QCD matter

**Authors:** Katsuya Inoue[1]; Kenji Fukushima[2]; Kenta Shigaki[3]; Wataru Yamauchi[1]; Yorito Yamaguchi[3]; Yoshimasa Hidaka[4]

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We propose a novel approach to probe primordial inhomogeneity in hot and dense matter which could be realized in noncentral heavy-ion collisions. We discuss the possibility of clustered substructures along the axis parallel to the magnetic field. Even if the magnetic field is short-lived, the pseudo-one-dimensional nature in the early dynamics can induce the inhomogeneity which could remain afterward as a metastable state. We propose an approach to probe the inhomogeneous state using the Hanbury Brown and Twiss (HBT) measurement. Although the HBT interferometry is commonly used to infer the system size, the cluster size should be detected if substructures emerge in space. We demonstrate in the Gaussian formalism that a signal peak in the HBT two-particle correlation stands at the relative momentum corresponding to the wave number of spatial pseudo-one-dimensional modulation. To assess the feasibility, we adopt the phase-space distribution with clustering of particles implemented in AMPT model and computed the two-particle correlation with the spatial sub-structures of density distribution. We find that the signal excess in the correlation ratio could be suppressed by the alignment of the magnetic axis but still persist under the appropriate momentum filter. Our results are promising enough and the HBT correlations should deserve further systematic investigations. Ref. K.Fukushima, Y.Hidaka, K.Inoue, K.Shigaki, and Y.Yamaguchi, PRC, 109, L051903, 2024.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **266**

## Nuclear shapes and spectator production

**Authors:** Govert Hugo Nijs[1]; Olaf Massen[2]; Priyanshi Sinha[None]; Raimond Snellings[2]; Wilke Van Der Schee[1]

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The production of spectator neutrons depends sensitively on the distribution of neutrons within a nucleus. In this talk we describe a relatively complete model that takes into account clusters forming among the spectators (charged or uncharged), the decay of such clusters using the Gemini code and lastly secondary neutrons produced by particpant nucleons. With this model we calibrate our parameters by a Bayesian analysis using the measured ZDC signal and its variation as a function of centrality for collisions of $^{208}$Pb. Our model motivates a careful analysis of both neutron and proton spectators during the upcoming oxygen special run at the LHC.

**Category**:

Theory

**Collaboration**:

**Poster Session / 270**

# Charmonium production at midrapidity using TRD-triggered data measured in ALICE

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Quarkonium production is considered one of the golden probes of quark-gluon plasma (QGP) formation in heavy-ion collisions. Quarkonium production in small collision systems is also important for investigating production mechanisms and providing a reference for heavy-ion collisions. Charmonium, a bound state of charm and anti-charm quark pairs, has its production mechanism described by perturbative QCD for heavy quark production and non-perturbative QCD calculations for the formation of the bound state. Measurements of J/$\psi$ and $\psi$(2S) cross sections in pp collisions are crucial for studying charmonium production mechanisms and testing different QCD-based model calculations. Especially, $\psi$(2S) production relative to J/$\psi$ provides strong discriminating power among quarkonium production models. Thanks to the ALICE online single-electron triggers from the Transition Radiation Detector (TRD), the $\psi$(2S) signal can be extracted at midrapidity via the dielectron decay channel.
In this contribution, the results on $p_{\mathrm{T}}$-differential $\psi$(2S) production cross section at midrapidity with the TRD-triggered data measured in ALICE in pp collisions at $\sqrt{s} = 13$ TeV will be shown for the first time, along with those for J/$\psi$. In addition, the excited-to-ground state yield ratio ($\psi$(2S)-to-J/$\psi$) at midrapidity will be discussed. Results will be compared to measurements at forward rapidity and available model calculations.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / 273

# A systematic primer for the rescattering of heavy flavor hadrons

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In this work, we systematically study the effects of hadronic rescattering on heavy flavored hadrons. With the hadronic transport approach SMASH, we create the most basic approximation of a hadronic afterburner – a thermalized and expanding sphere of hadron gas –, where we observe the "pion wind" phenomenon and its dependence on the cross section assumption. Further in complexity, we introduce fast-moving heavy mesons, arisen from quarks created in the initial hard scatterings. They are slowed down nearly independently of the initial momentum, hinting at thermalization. They are also deflected in the medium by an amount that depends on which cross sections are used, possibly hinting at the mechanism for anisotropic flow generation. Within this setup, we also see a depletion in charmonia due to the process $J/\Psi(+N) \rightarrow D\bar{D}(+N)$. Moreover, due to the large (semi)leptonic branching ratio, the rescattering of heavy hadrons decreases the phase space of resulting dileptons, so we investigate how this affects their opening angle and invariant mass spectra. Such a study on a comprehensive set of observables related to heavy flavor hadrons is the first step for higher precision predictions in full dynamical hybrid approaches.

**Category**:

Theory

**Collaboration**:

**Poster Session** / 276

# Novel use of generative AI for heavy ion experiments

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Generative AI that is data-driven and self-supervising has shown significant potential to transform both science and industry. In this talk, we present two novel applications of generative AI in heavy ion experiments.

1. The first application involves full-detector, whole-event simulation of heavy ion collisions using denoising diffusion probabilistic models (DDPMs). Our studies [in submission] demonstrate that DDPMs significantly outperform a popular rival, generative adversarial networks (GANs), offering much faster generation times compared to Geant4 simulations, with a speedup on the order of 100.
2. The second application is a new approach to jet background subtraction using unpaired image-to-image translation models. Specifically, our work with UVCGAN [arXiv:2303.16280, arXiv:2304.12858], an optimized CycleGAN model, shows excellent performance in separating jets in the calorimeter tower grid from the combinatorial background in heavy ion collisions.

For both applications, we examine the limitations and potential biases of AI models as scientific tools and discuss optimizations to enhance their accuracy and reliability.

**Category**:

Experiment

**Collaboration**:

sPHENIX

**Poster Session** / **278**

## Probing the medium with heavy quark using effective field theory

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We develop an effective field theory (EFT) formalism to study the interaction of a heavy quark with the medium. All the operators consistent with the underlying symmetry and power counting in $l_{\rm hydro}$, the hydrodynamic length scale, are written down. Using these EFT principles leads to only few general operators which are organized in terms of order of importance. The Wilson coefficients for these operators, which provides the coupling of the heavy quark to the hydrodynamic medium, can then be estimated from experiments directly in the non-perturbative regime or obtained from an ultraviolet theory in a perturbative regime by matching to it.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **279**

## Charged beauty-tagged jet measurement with impact parameter method in proton–proton collisions in Run3

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Heavy-flavour jets, defined as collimated bunches of hadrons originating from the fragmentation of heavy-flavour quarks such as beauty quarks, are produced in high-energy collisions. The cross section of heavy-flavour quark production can be calculated using perturbative quantum chromodynamics (pQCD) due to their generation through high momentum transfer at low $p_T$, attributed to their significant mass.
Since heavy-flavour quarks are created in the initial stages of collisions, before the formation of the quark-gluon plasma (QGP), they serve as effective probes for studying QGP properties. With the ALICE detector's upgrades for Run 3, a significant increase in statistics and spacial resolution have been achieved, enhancing the precision and significance of cross-section analyses of heavy-flavor

jets. The heavy-flavour jets can be identified by impact parameter distribution of their constituents, since heavy-flavour hadrons have much longer lifetimes than light-flavour hadrons.
In this study, we will present the first look with ALICE at heavy-flavour jet tagging using the impact parameter method in pp collisions at $\sqrt{s} = 13.6$ TeV in Run 3.

**Category**:

Experiment

**Collaboration**:

**Poster Session / 281**

# Study of Neutron Irradiation of p-type Silicon Sensor for future calorimeter

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**Co-authors:** Atsushi Taketani [2]; Jonghan Park [3]; Keita Okui [3]; Koshiro Yoda [3]; Machiko Hatsuda [4]; Mai Takamura [1]; Maya Shimomura [1]; Motoi Inaba [3]; Shingo Sakai [3]; Subaru Ito [3]; Taichi Inukai [3]; Takashi Hachiya [1]; Tatsuya Chujo [3]; Tomohiro KOBAYASHI [5]; Yoshiki Wakabayashi [6]; Yui Ishigaki [1]; Yuji Goto [6]

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Quarks and gluons, normally confined within hadrons by strong interactions, are released from the confinement at high temperatures and densities, which is called Quark-Gluon Plasma (QGP). To understand QGP, high-energy heavy ion collision experiment has been conducted in laboratory and research has been carried out to investigate its property. One unknown about QGP is that it reaches thermal equilibrium much earlier than theoretically expected, and Color Glass Condensation (CGC) is a strong candidate to explain this. The silicon electromagnetic calorimeter has been developed to study the CGC experimentally.

Since this calorimeter will be installed in the forward region where it will be exposed to large neutron dose, it is necessary to investigate the radiation tolerance of the p-type Silicon sensor which is considered to be used for this calorimeter due to high neutron tolerance. To evaluate this, neutron irradiation tests were conducted at the RIKEN (RANS) in July 2023 and May 2024.

In these tests, Indium foil, which is sensitivity to the amount of neutron irradiation was placed around the Si sensor and irradiated with neutron beam of about $10^{14} n_{eq}/cm^2$ at the maximum, as assumed in the ALICE experiment. Since the neutron dose depends on the distance from the beam, it is necessary to estimate the dose of the Si sensor by analyzing the Indium foil dose. In this poster, an overview of these tests and the status of dose analysis using Indium foil will be discussed.

**Category**:

Experiment

**Collaboration**:

**Poster Session / 282**

# Position alignments and vertex determination for sPHENIX INTT detector

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The sPHENIX experiment has been taking data since 2023 at the Relativistic Heavy Ion Collider(RHIC) at Brookhaven National Laboratory, USA. We aim to study the properties of the Quark-Gluon Plasma. The INTT consists of two cylindrical layers of silicon detectors that can precisely measure the passage positions of charged particles. By using the collision point (vertex) of ions and the measurement points from the INTT, we can reconstruct the particle tracks.
The collision vertex is spread within ˜10cm in z direction at the interaction region because of 2m radian crossing angle of the beams. It is necessary to determine z-vertex position event by event basis precisely.We developed the vertex determination method using INTT and studied its performance using some different algorithms.
In addition, the position alignment of the INTT sensors are an important parameter for not only INTT vertexing but also track reconstruction associated with inner and outer trackers. We studied the alignment using the straight line tracks measured in p+p collision with no magnetic field.
In this poster, we will report the current status of INTT vertex determination and INTT alignment using the p+p data recorded in 2024.

**Category**:

Experiment

**Collaboration**:

sPHENIX

**Poster Session / 283**

# Measurement of identified charged-hadron and pi0 production in p + Al, 3He +Au, Cu + Au, and U + U collisions at PHENIX

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The small-system collisions (p/d/He+A) became of great interest since the finding of the flow of the particles which had been considered as a strong signature of the QGP production. On the hard and EM probes side, those that have been measured to characterize the QGP, such as Jets (or high pT hadrons), heavy flavor hadrons, and direct/thermal photons, have also been measured in the small system collisions. One interesting result on the direct photons showed that their yields scale with the dN/dy to the power of 1.2, from the large systems down to the central collisions in the small systems. The measurement of identified hadrons over wide range of pT from small to large systems is one of the promising tools to shed light on particle production in both soft and hard sectors, which cross-checks and helps to understand results coming from hard and EM processes. In this presentation, identified charged-hadron invariant pT and mT spectra, nuclear-modification factors and particle ratios, in p + Al, 3He +Au, and Cu + Au collisions at sqrt(s_NN) = 200 GeV and in U+U collisions at sqrt(s_NN) = 193 GeV measured by PHENIX are shown. And the physics interpretations including collective flow aspects for those measurement are presented. The values of freeze-out temperatures and average collective velocities have been obtained. It should also be noted that v2 flow values and pi0 productions in those various collision systems, have been measured by the PHENIX.

**Category**:

Experiment

**Collaboration**:

PHENIX

**Poster Session** / **291**

## Non perturbative effect in charm diffusion and flow from Gribov-Zwanziger approach

**Authors:** Guangyou Qin[1]; Weiyao Ke[1]; Xueqiang Zhu[2]

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Due to the longer relaxation time of heavy quarks compared to light quarks in the quark-gluon plasma, the non-equilibrium information is expected to be retained in the final momentum distribution of heavy flavors, making them suitable probes of the strongly interacting system. Using the Gribov-Zwanziger prescription to model the infrared behavior of QCD, we study the momentum diffusion coefficient $\kappa$ of the charm quark and its dependence on both the medium temperature and the heavy quark momentum. We will also discuss the role played by the modified IR behavior in computing the diffusion coefficient. The scaled momentum diffusion coefficient is found to increase with momentum and decrease with the temperature. Finally, we implement this diffusion coefficient in the LIDO transport model and apply it to phenomenology and compare to open-charm $R_{AA}$ and $v_2$ data.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **293**

## Direct photon emission of QCD matter with Tsallis statistics

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Nonextensive statistics [1] has attracted attention as a description of an extended range of hadronic particle spectra in nuclear collisions. In this study, we consider a relativistic hydrodynamic model with Tsallis statistics [2] to estimate direct photons, which are a prominent observable for understanding the properties of the QCD matter. Nonextensivity enters the model via the modification of (i) the space-time evolution of the system and (ii) the photon emission rate. Direct photon spectra and elliptic flow are estimated in numerical simulations.

[1] C. Tsallis, J. Statist. Phys. 52, 479 (1988)
[2] K. Kyan, A. Monnai, Phys. Rev. D 106, 054004 (2022)

**Category**:

Theory

**Collaboration**:

**Poster Session** / **295**

## Development and Simulation of Backward Hadronic calorimeter for the ePIC detector at EIC

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The Electron-Ion Collider (EIC) is a future particle accelerator at Brookhaven National Laboratory. It will provide physicists with high luminosity and highly polarized beams with a wide range of nuclei species at different energies, covering an extensive kinematic range, which will provide unprecedented access to the spatial and spin structure of proton, neutron, and light ions. The EIC physics goals include measuring the Generalized Parton Distribution, performing precision 3D imaging of the nuclei structure, and studying color confinement and hadronization mechanisms.
The backward hadronic calorimeter (backward HCal) for the Electron-Proton/Ion Collider experiment(ePIC) is a tail-catcher type calorimeter under development, which is to be located in the electron-going direction. In order to meet the physics goals of the EIC, a high position resolution backward hadronic calorimeter is needed to measure and distinguish charged and neutral hadronic showers coming from jets originating from fragmentation of small-x partons. The planned design type is a sandwich calorimeter with alternating layers of non-magnetic steel and plastic scintillator with wavelength-shifting fibers(Fe/SciFi). The light readout will be provided by Silicon Photomultipliers. It will cover the pseudorapidity range $-3.5 < \eta < -1.2$. We will present a comprehensive overview with study on position resolution, clustering optimization, low energy neutron detection and separation.

**Category**:

Experiment

**Collaboration**:

EPIC

**Poster Session** / **297**

## b-jet tagging in pp collisions using graph neural network with the ALICE experiment

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Beauty-jets (b-jets) refer to sprays of collimated particles produced from the fragmentation of beauty quarks generated in hard scatterings at collider experiments. Compared to jets produced by the fragmentation of light quarks and gluons, b-jets are characterised by the presence of displaced secondary vertices, due to the decay of beauty hadrons which have a relatively long lifetime ($c\tau \sim 500$ µm). Therefore, they can be tagged by exploiting the decay topology using traditional methods based on the impact-parameter (IP) of their constituents or the reconstruction of secondary vertices (SV).

These methods however have a limited performance. Graph Neural Network (GNN) is a deep learning method capable of considering the relationship between the constituent tracks, and extracting features of jets by treating them as graphs consisting of tracks. Hence, GNN is expected to demonstrate outstanding b-jet tagging performance. On this poster, we will introduce the structure and training process of GNN, and present the b-jet tagging performance of the GNN which is trained using ALICE Monte Carlo data.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session** / **298**

## (Non-)Perturbative aspect of the high multiplicities in jets

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The recent CMS jet measurement provides new insights into understanding the QCD hard processes in the high-multiplicity limit (with $n > 100$ tracks in jet). In this study, we aim to understand the dynamics that gives the broad multiplicity distribution $P(n)$ in the jet and the origin of the high-multiplicity tail. We start with a set of assumptions on the multiplicity distribution coming from a single parton fragmenting in the non-perturbative regime, and then, consider NLO parton splitting corrections to the multiplicity distribution. Taking a pure gluonic and exclusive jet as a toy example, we found that the NLO correction to the multiplicity distribution $P(n)$ receives a double-logarithm contribution from the collinear-soft region and a non-linear, single-logarithm enhancement from the collinear region. We propose an evolution equation that connects the multiplicity distribution from low to high energy scales. We analyze the behavior of the equation and apply it to the phenomenology of high multiplicity jets.

**Category**:

Theory

**Collaboration**:

**Poster Session** / **300**

## Probing medium response by measuring (anti-)proton to pion ratio and charged particles radial profile with jet in Pb-Pb and pp collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV with ALICE Primary tabs View(active tab)

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Comparisons of jet production in Pb–Pb collisions compared to pp collisions at LHC energies provide vital information on both jet quenching in the quark-gluon plasma (QGP) and on the medium response to the jet. Jet quenching models with a hydrodynamic medium response predict an enhancement of soft particle production at large angles from the jet axis. However, the mechanism of soft particle production at large angles still remains elusive. Measurements of particle composition within jets, jet hadrochemistry, may provide new experimental insights on the medium response of the QGP. In this poster, we present the results of particle density profile $\rho$ for charged particles, as well as the ratios of (anti-)protons to charged pions as a function of their transverse momenta and distance from the jet axis. Particle identification (PID) is performed by utilizing the Time Projection Chamber, the Time of Flight detector, and the Inner Tracking System of ALICE. Jets are reconstructed from charged particles with the anti- algorithm with several jet resolution parameters. These jets are selected with $p_{\mathrm{T}}^{jet\ ch} > 60$ GeV/$c$ after subtraction of the underlying event. The obtained results will be compared with theoretical models containing medium response to understand the mechanisms of soft particle production away from the jet axis.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session / 301**

# Measurements of inclusive J/$\psi$ and $\psi$(2S) production at midrapidity in pp collisions at $\sqrt{s}$ = 13.6 TeV with ALICE

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Quarkonium production in high-energy proton-proton (pp) collisions is an important tool for studying perturbative and non-perturbative aspects of quantum chromodynamics. Charmonia are bound states of charm and anti-charm quarks and their production process can be factorized into two stages: the heavy quark production and the formation of the bound state. The former happens within initial hard parton-parton scatterings with large momentum transfers, and can be well described by perturbative QCD. The second one, which involves long distances and soft momentum scales, is a typical non-perturbative process. Measurements of J/ψ and ψ(2S) cross section in pp collisions are crucial for studying charmonium production mechanisms and testing different QCD-based model calculations. They can also provide a reference for investigating the quark-gluon plasma formed in nucleus-nucleus collisions and the cold nuclear matter effects in proton-nucleus collisions.
In this poster, we will present the results of inclusive J/ψ and ψ(2S) production at midrapidity in pp collisions at √s = 13.6 TeV. The analysis is based on the data collected in 2022 by the upgraded ALICE detector during LHC Run 3, which offers significantly higher statistics compared to Run 1 and 2. The $p_{\mathrm{T}}$-differential production of inclusive J/ψ cross section, as well as the ψ(2S)-to-J/ψ ratio, will be reported. Results will be shown along with similar measurements at forward rapidity and compared with model calculations.

**Category**:

Experiment

**Collaboration**:

ALICE

**Poster Session / 302**

# Production of electrons from open beauty-hadron decays in pp collisions at √s = 13 TeV with ALICE

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In proton-proton (pp) collisions, beauty quarks are produced in hard scattering processes, and therefore their measurements represent an important test of perturbative QCD calculations. Moreover, measurements in pp collisions are needed to provide a baseline for those performed in p–Pb and Pb–Pb collisions. In addition, the production yields as a function of charged-particle multiplicity can give us an insight into multi-parton interactions (MPI) and the interplay between hard and soft mechanisms in particle production.

In this contribution, we report on inclusive and multiplicity-dependent production of electrons from beauty-hadron decays in pp collisions at $\sqrt{s} = 13\,\mathrm{TeV}$ collected by ALICE during LHC Run 2. The inclusive production cross section is compared to pQCD calculations and to a similar measurement of electrons from open heavy-flavour decays in pp collisions at $\sqrt{s} = 13\,\mathrm{TeV}$. The multiplicity-dependent production yields are compared to those of open heavy-flavour decay electrons in the same collision systems and to model predictions.

**Category**:

Experiment

**Collaboration**:

**Poster Session / 304**

# $\Lambda_c - N$ interaction form Lattice QCD at physical point

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We investigate $\Lambda_c - N$ interaction in the spin singlet channel ($^1S_0$) and the spin triplet coupled channel ($^3S_1 - {}^3D_1$) from lattice QCD by using HAL QCD method. We perform the first physical point simulation by employing gauge configurations generated by the HAL Collaboration at $m_\pi \simeq 137$ MeV, $m_K \simeq 502$ MeV, and $a \simeq 0.0844$ fm on $96^4$ lattices (HAL-Conf-2023) in which a high statistical precision was achieved by 8000 Monte Carlo trajectories. Our calculations of the $\Lambda_c - N$ potential show a weak mid-range attraction and a short-range repulsive core. This is qualitatively similar to the results obtained in our previous calculations at heavier pion masses, $m_\pi \simeq 410,\ 570,\ 700$ MeV, while the current results at the physical point indicate a shallower mid-range attraction compared to the previous results. With the ALICE upgrade for LHC Run-3, which aims for a fifty-times increase in recorded collisions, the increased statistics of charm baryons may enhance the feasibility of the measurements of $\Lambda_c - N$ femtoscopic correlations, making it possible to analyze the $\Lambda_c - N$ interaction by both lattice QCD and experimental data. The present results at the physical point with the coupled-channel effect would also make a significant impact on the studies of $\Lambda_c - N$ interactions based on chiral effective field theory.

**Category**:

Theory

**Collaboration**:

HAL QCD

**Poster Session** / **305**

## Quantifying in-medium jet structure modification and medium response with direct photon and pi-zero triggered hadron correlations in PHENIX

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Jet measurements have long established that as hard scattered partons traverse the quark gluon plasma (QGP) they lose energy resulting in modified jets in A+A collisions relative to p+p collisions with no QGP. Understanding how the jets, their constituents and substructure are modified is crucial to discriminating between energy loss models and extracting the in-medium transport properties. Equally important is quantifying the response of the medium to this lost energy and disentangling such effects from the modified parton showers. By triggering on a high momentum hadron and measuring the distribution of hadrons opposite it in azimuth, we can study the particles correlated with the opposing jet. Model comparisons to the PHENIX $\pi^0$−hadron correlations suggest that medium response plays an important role for describing the low momentum hadron distribution. PHENIX has final results for the ratio ($I_{AA}$) and difference ($\Delta_{AA}$) of Au+Au to p+p as a function of the azimuthal angle. In addition, PHENIX is extracting these observables using direct photons as a trigger. The unmodified direct photon provides access to the kinematics of the initial hard scattering and selects a population of opposing jets predominantly from quarks. These measurements utilizing the highest statistics PHENIX 200 GeV Au+Au data set are also complimentary to LHC Z boson-track correlation studies, by exploring lower momentum jets at RHIC and further constraining energy loss models.

**Category**:

Experiment

**Collaboration**:

PHENIX

**Poster Session** / **307**

## First study of azimuthal correlations of electron-muon pairs from heavy-flavor decays in proton-proton collisions with ALICE

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In high-energy hadronic collisions, heavy flavors are a sensitive tool for studying the physics of strong interactions. In particular, heavy-flavor measurements in proton-proton (pp) collisions are most suitable to test QCD calculations and serve as baseline for studies in heavy-ion collisions. One measurement particularly sensitive to the production mechanism of heavy quarks is the azimuthal correlation distribution of lepton pairs generated from heavy-flavor hadron decays. More specifically, heavy-flavor quark pairs can be produced by leading-order (LO) processes, characterized by back-to-back azimuthal correlation of the two quarks, or next-to-leading-order (NLO) processes, with a different correlation pattern. The relative contribution of LO and NLO processes can be investigated from the azimuthal correlation distribution of the final-state heavy-flavor particles, and it is possible to set constraints to theoretical models describing this observable by comparing their predictions to the measurements. In this study, we use electron-muon pairs, which allow us to perform clean measurements that suppress e.m. processes conserving the lepton number, as Drell-Yan process and resonance decays. In this poster, we report the current status of the analysis of the measurements of azimuthal correlations of electron-muon pairs from heavy-flavor hadron decays in pp collisions at √s=13.6 TeV

**Collaboration**:

ALICE

**Category**:

Experiment

**Poster Session** / **309**

## Intermediate Silicon Tracker in sPHENIX at RHIC

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The sPHENIX collaboration has been taking data since 2023 at the Relativistic Heavy Ion Collider in BNL to study the Quark-Gluon Plasma and cold-QCD. A detector complex consisting of the solenoid magnet, a hadron calorimeter, an electromagnetic calorimeter, a time projection chamber, a MAPS-based vertex detector, and the intermediate silicon tracker (INTT). A tracking system formed by the three latter detectors enables us to measure the heavy flavor jets and identify the three upsilon states. The INTT surrounding the collision point azimuthally at about 10 cm away with two layers of silicon strip sensors detects hit points at the intermediate area of the tracking system to have better tracking precision. In addition to that, the INTT also provides timing information to tracker hits, which is possible only by INTT, thanks to its good timing resolution, to eliminate pile-up events by misidentifying bunch-crossing. This poster presentation will show the status of commissioning with proton-proton collision runs this year and achievements using Au-Au collision data taken in 2023.

**Category**:

Experiment

**Collaboration**:

sPHENIX

**Poster Session** / **311**

# Event-by-event mean transverse momentum fluctuations in pp collisions at $\sqrt{s}$ = 13 TeV using ALICE detector

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High-multiplicity triggered events produced in pp collisions at $\sqrt{s} = 13$ TeV collected by ALICE detector are analyzed to study the mean transverse momentum ($p_{\mathrm{T}}$) fluctuations. The study is inspired by the idea that non-monotonic changes in $p_{\mathrm{T}}$ correlations vary with energy and, if observed, may be taken as an indicator for the {\footnotesize QGP} formation. The finding reveals that the values of the two-particle correlator, $\sqrt{C_m}/M(p_T)_m$ decreases with increasing charged particle density and exhibits a power-law behavior similar to those reported for pp and Pb–Pb collisions at lower energies. In order to look for effects of jets and minijets, dependence of correlator, $\sqrt{C_m}/M(p_T)_m$ on charged particle density is examined by applying different $p_{\mathrm{T}}$ selection and comparing the behavior of the correlator observed for low $p_{\mathrm{T}}$ to high $p_{\mathrm{T}}$ ranges. The findings based on the data are also compared with the predictions of various Monte Carlo models.

**Category**:

Experiment

**Collaboration**:

ALICE

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# Applications of monolithic CMOS pixel sensor to medical physics

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In recent years, CMOS silicon pixel detectors have seen significant advancements and a widespread usage across various physics fields, allowing for significant improvements of the particle detection technologies. One relevant example is the ALPIDE chip, which is a CMOS Monolithic Active Pixel Sensor developed for the upgrade of the Inner Tracking System of the ALICE experiment at the LHC. On top of its excellent capabilities for high-energy particle physics, its excellent spatial resolution and charged-particle detection efficiency, very limited noise and fake-hit rate, and reduced sensitivity to photons make it suited for several applications in medical physics.
In this contribution we will show recent developments for two applications in this field being currently investigated. In particular, we will discuss the concept of a Compton chamber using as scatterer element multiple stacks of ALPIDE chip, to cover a large enough sensitive volume, to be used for the online monitoring of hadrontherapy proton or ion beams. We will also report on the perspectives for the development of an intraoperative probe containing an ALPIDE chip as sensitive element, with online imaging capabilities, to be exploited in radioguided surgery in association to beta-emitting radiotracers.

**Category**:

Experiment

**Collaboration**:

ALICE

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# Poster [Test]

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**Collaboration**:

**Category**:

Theory