The 16th Workshop on QCD Phase Transition and Relativistic Heavy-Ion Physics (QPT 2025)

Report of Contributions

https://indico.ihep.ac.cn/e/25521

Contribution ID: **7** Type: **Oral**

QGP Thermalization in Early Stage —Entropic Manifestetion of Multi-particle Entanglement in Early Stage of HIC

Sunday, 26 October 2025 17:15 (20 minutes)

The early-stage thermalization of the Quark-Gluon Plasma (QGP) is important process in high energy collision. However, our understanding of thermalization of isolated quantum systems in this stage stills remains limited. This talk aims to explore QGP thermalization from the perspective of entropy in isolated many-body quantum systems. To solve the long-standing problem of the entropy paradox of pure quantum state, we introduce a new notion of correlation entropy based on the symmetry of many-body correlations (the E group) and its representations. I shall derive a more subtle relation that makes a precise connection between many-body entanglement and thermalization. Building on this framework, I will demonstrate how the spontaneous breaking of correlation symmetry leads to effective entropy, with key properties such as the extensivity, which is non-trivial in understanding thermalization of isolated quantum system and partially solving the difficulty of entanglement description in BH (black hole) information paradox hopefully.
Finally, I will present examples involving spin correlations and evolving many-body quantum systems. Experimental data and simulations in heavy ion collision for the QGP entropy evaluation will be discussed.
Further topics can be discussed include the transition from low to high temperatures, peculiar features of ground state entropy, and other aspects characterizing entropy during thermalization.

Primary author: 梁, 晨曦 (复旦大学现代物理研究所)

Co-author: YAN, Li (复旦大学)

Presenter: 梁, 晨曦 (复旦大学现代物理研究所)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **8** Type: **Oral**

spin dynamics in intermediate-energy heavy-ion collisions

Sunday, 26 October 2025 08:45 (20 minutes)

While the spin polarization of hyperons and the spin alignment of vector mesons become a hot topic in relativistic heavy-ion collisions, the spin dynamics in intermediate-energy heavy-ion collisions has attracted little attention. Starting from the spin-dependent Boltzmann-Vlasov equation, we have derived the spin-dependent equations of motion for nucleons, and developed a spin- and isospin-dependent Boltzmann-Uehling-Uhlenbeck transport model. It has been found that the nucleon spin polarization can be generated from either the spin-dependent mean-field potential or the spin-dependent nucleon-nucleon scatterings.

Primary author: 徐, 骏 (同济大学)

Presenter: 徐, 骏 (同济大学)

Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **9** Type: **Oral**

Spin Alignment, Phase Transition and Transportation of QGP at Finite Temperature in the Presences of Magnetic and Vorticity Fields

Monday, 27 October 2025 08:20 (20 minutes)

We study the two-flavor Nambu-Jona-Lasinio model under the rotation and chiral chemical potential μ5. First, the influence of chiral imbalance on the chiral phase transition in the Tpc – ω plane is investigated.
And then by incorporating AMM at the quark level, we find that AMM significantly alters the magnetic field dependence of constituent quark masses, inducing first-order phase transitions for light quarks at critical fields, while strange quarks exhibit non-monotonic mass behavior. The inclusion of AMM reshapes the QCD phase diagram, suppressing chiral transition temperatures and shifting critical endpoints (CEP) toward lower μ and T. Notably, crossover transitions observed without AMMare replaced by first-order transitions under strong fields, aligning with lattice QCD predictions for IMC. For mesons, AMM triggers abrupt mass collapses and enhances flavor mixing, accelerating chiral restoration for K and η mesons via thresholds tied to strange quark masses.

The impact of rotation on the deconfinement phase transition under the Einstein-Maxwell system of the soft and the hard wall models in holographic quantum chromodynamics is studied. The metric by cylindrical coordinates with rotation is introduced into the system to calculate the Hawking temperature. The first holographic study on the influence of the radius of a homogeneous rotating system on the phase diagram is proposed.

Primary author: 冯, 笙琴 (三峡大学理学院)

Presenter: 冯, 笙琴 (三峡大学理学院)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **12** Type: **Oral**

The application of machine learning in holographic QCD

Sunday, 26 October 2025 09:25 (20 minutes)

In this talk, I will present the application of machine learning in holographic QCD. By incorporating the equation of state and baryon number susceptibility data, we leverage machine learning techniques to construct a holographic model capable of predicting the location of the critical endpoint (CEP). Furthermore, we enhance the model using Bayesian inference, providing a refined CEP prediction that accounts for uncertainties from lattice QCD. Additionally, we apply the constructed model to compute various physical observables, including transport properties and the heavy quark potential.

Primary author: 陈, 勋 (Central China Normal University)

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Presenter: 陈, 勋 (Central China Normal University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **13** Type: **Oral**

Onset of hydrodynamics in a strongly coupled system based on quantum many-body calculation

Sunday, 26 October 2025 16:55 (20 minutes)

Onset of hydrodynamics in the hot medium created in relativistic heavy-ion collisions is a crucial theoretical question. Addressing this problem in a first-principle manner, requires a **real-time, non-perturbative simulation of a large scale quantum system**, as hydrodynamic behavior emerges only when approaching the continuum limit. The exponentially large Hilbert space of quantum states prevents an exact simulation on classical hardwares. To overcome such a difficulty, we perform such a simulation using the Tensor Network method, which enables simulations of a reduced representation space of large scale quantum many-body systems by keeping only the most essential quantum states contributing to macroscopic quantities.

We focus on the massive Schwinger model, a low-dimension analog of quantum chromodynamics (QCD), as it shares the important properties such as confinement and chiral symmetry breaking. Starting from an initial quantum state that mimics hard particle collisions, we *observe the onset of hydrodynamic behavior* that is **consistent with the Bjorken-flow** in all hydrodynamic degrees of freedom: *energy density, fluid velocity, and bulk pressure*. The time scale for the onset of hydrodynamics is found to be consistent with the thermalization time of the quantum distribution function. Both time scales are of the same order as the hydrodynamization time determined by fitting the experimental data, upon a physical matching that extrapolates the 1+1 dimensional Schwinger model to the 3+1 dimension QCD.

Primary authors: 邵, 海洋 (清华大学); SHILE, Chen (Tsinghua University); SHI, Shuzhe (Tsinghua University)

Presenter: 邵, 海洋 (清华大学)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **17** Type: **Oral**

Probing QGP droplets with charmonium in high-multiplicity proton-proton collisions

Monday, 27 October 2025 08:20 (20 minutes)

We study the hot medium effects in high-multiplicity proton-proton (pp) collisions at 13 TeV via the charmonium probes. The hot medium is described with the hydrodynamic model, while charmonium evolutions in the medium are studied with a time-dependent Schr¨odinger equation. The hot medium dissociation on charmonium is considered with the temperature-dependent complex potential parametrized with the results from lattice QCD calculations. The ratio ψ(2S)/J/ψ of J/ψ and ψ(2S) production cross sections are calculated and compared with the LHCb experimental data in pp collisions. Our calculations explain the charmonium relative suppression in different transverse momentum and multiplicity bins. The suppression of this ratio is mainly affected by the effects of the deconfined medium. It is less affected by the initial effects before the generation of the heavy quark pair. We suggest this to be a clear signal of the small QGP droplets generated in high multiplicity pp collisions.

Primary author: CHEN, Baoyi (Tianjin University)

Presenter: CHEN, Baoyi (Tianjin University)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **18** Type: **Oral**

Hydrodynamic effects on spin polarization in AA and pA collisions

Sunday, 26 October 2025 09:25 (20 minutes)

We have implemented the 3+1 dimensional CLVisc hydrodynamics model with \trento-3D initial conditions to investigate the spin polarization of Λ hyperons along the beam direction in p+Pb collisions at $\sqrt{s_{NN}} = 8.16$ TeV. Following our previous theoretical framework based on quantum kinetic theory, we consider three different scenarios: Λ equilibrium, s quark equilibrium, and iso-thermal equilibrium scenarios. We have computed the second Fourier sine coefficients of spin polarization along the beam direction, denoted as $\langle P_z \sin 2(\phi_p - \Psi_2)\rangle$, with $\phi_p - \Psi_2$ being the azimuthal angle relative to the second-order event plane Ψ_2, as functions of multiplicity, transverse momentum and pseudo-rapidity in the three scenarios. Additionally, we have also computed the spin polarization along the beam direction, P_z, as a function of the azimuthal angle. We find that the spin polarization induced by thermal vorticity always provides an opposite contribution compared to the shear-induced polarization in p+Pb collisions. The total spin polarization computed by the current hydrodynamic model disagrees with the data measured by LHC-CMS experiments.

Primary authors: YI, Cong (USTC); WU, Xiang-Yu (Central China Normal University); PU, Shi (University of Science and Technology of China); QIN, Guang-You (Central China Normal University)

Presenter: YI, Cong (USTC)

Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **21** Type: **Oral**

Search for the Strange Dibaryons with Baryon Correlations at STAR

Monday, 27 October 2025 09:00 (20 minutes)

Dibaryons, exotic states composed of six quarks, have long been a subject of interest in understanding the strong interaction beyond conventional hadrons. Among these, strange dibaryons, which contain strange quarks, offer an important role of studying the hyperon-nucleon (YN) and hyperon-hyperon (YY) interactions . Of particular interest are the spin-0 H (S = -2) and the spin-2 $N\Omega$ (S = -3) dibaryon state, which are considered promising candidates for the strange dibaryon bound state. In heavy-ion collisions, two-particle femtoscopy is a powerful and unique method for extracting information about the spatio-temporal properties of the source, characterising the final state interactions (FSI), and searching for the possible bound states.

In this talk, we will present the measurements of baryon-baryon correlation functions, including p-Ξ^-, Λ-Λ and p-Ω^- pairs, in Isobar (Ru+Ru, Zr+Zr) and Au+Au collisions. The correlation functions are analyzed within the Lednicky-Lyuboshitz formalism. The extracted scattering length and effective range will be presented. Those measured parameters will be compared with recent Lattice QCD and effective theory model calculations. Most importantly, the physics implications for the formation of strange dibaryon (S = -2 and S = -3) bound state will be discussed.

Primary author: ZHANG, Kehao (华中师范大学)

Presenter: ZHANG, Kehao (华中师范大学)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **24** Type: **Oral**

Heavy Quarkonium Dissociation Using Deep Learning–Driven Medium Parameters

Sunday, 26 October 2025 15:25 (20 minutes)

We present a machine learning–based framework for modeling temperature-dependent non-perturbative quantities in the quark-gluon plasma (QGP), aimed at improving predictions for heavy quarkonia suppression in high-energy nuclear collisions. Deep neural networks are trained on lattice data to extract temperature profiles of the Debye screening mass $m_D(T)$ and the QCD running coupling $\alpha_s(T)$. These learned profiles are incorporated into a potential model to compute quarkonium thermal widths and binding energies by numerically solving the Schrödinger equation with a complex, medium-modified heavy-quark potential.

To determine dissociation temperatures T_d, we employ two complementary criteria: the upper bound criterion $2E_B = \Gamma_{\text{th}}$, [1], and the lower bound criterion $E_B = 3T$, [2]. This unified ML-based approach enables a data-driven estimation of quarkonia dissociation across a broad temperature range, providing improved consistency with lattice QCD results and experimental suppression patterns observed in relativistic heavy-ion collisions. The framework offers a robust extension beyond perturbative techniques and can be adapted to model in-medium evolution in both isotropic and anisotropic backgrounds.

References:

1: A. Mocsy and P. Petreczky, Phys. Rev. Lett. 99, 211602 (2007)

2: S. Digal, P.Petreczky and H.˜Satz, Phys. Lett. B 514, 57-62 (2001)

Primary authors: Dr JAMAL, MOHAMMAD YOUSUF (Central China Normal University Wuhan); Dr LI, Fu-Peng (Central China Normal University); 庞, 龙刚 (C); QIN, Guang-You (Central China Normal University)

Presenter: Dr JAMAL, MOHAMMAD YOUSUF (Central China Normal University Wuhan)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **25** Type: **Oral**

Two-Particle Correlations of Light Nuclei and Hyperons in Heavy-Ion Collisions at STAR

Monday, 27 October 2025 08:40 (20 minutes)

Heavy-ion collisions provide a unique environment to study nucleon-nucleon (N-N) and hyperon-nucleon (Y-N) interactions, as well as the production mechanisms and structure of light (hyper)nuclei. Two-particle correlations at small relative momenta serve as a powerful tool, carrying rich information about the space-time evolution of the particle-emitting source and the effects of final-state interactions (FSI). In particular, correlations involving light nuclei—such as deuteron (d), triton (t), helium isotopes (^{3}He)—and hyperons like Λ can shed light on both the internal structure and binding energies of (hyper)nuclei, as well as many-body interactions among baryons. These studies are crucial for understanding dense baryonic matter, including the equation of state of neutron stars.

In this talk, we present the first measurements of a broad set of two-particle correlation functions involving proton and light nuclei combinations (p-d, d-d) as well as hypernuclear correlations (d-Λ, t-Λ, ^{3}He-Λ), using high-statistics data from $\sqrt{s_{\rm NN}} = 3$ GeV (fixed-target mode) recorded by the STAR experiment at RHIC. The correlation functions are analyzed using the Lednicky–Lyuboshitz formalism to extract key parameters such as source size, scattering length, and effective range. The extracted parameters will be compared to those from other baryon correlations and various effective theory model calculations. Finally, the implications of these results for the production mechanisms of light nuclei and the final-state interactions involving hyperons—especially as they relate to the internal structure of light hypernuclei—will be discussed.

Primary author: MI, Ke (中国科学院大学)

Presenter: MI, Ke (中国科学院大学)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **26** Type: **Oral**

重离子碰撞中椭圆流分裂行为的研究:TRENTO-3D + CLVisc 模拟

Sunday, 26 October 2025 08:45 (20 minutes)

Using the TRENTo-3D initial condition model coupled with (3+1)-dimensional CLVisc hydrodynamic simulations, we systematically investigate the left-right splitting of elliptic flow (Δv_2) for soft particles in relativistic heavy-ion collisions. Our study reveals that the final distribution characteristics of Δv_2 are primarily depend on the odd flow harmonics and v_2 itself.
We find that the parton transverse momentum scale k_{T} not only determines the geometric tilt of the QGP fireball but also significantly affects the rapidity dependence of both v_1 and Δv_2, providing new insights into the splitting mechanism of Δv_2.
Furthermore, our results demonstrate that $\Delta v_2(p_{\mathrm{T}})$ exhibits significant sensitivity to influences such as the sub-nucleonic degrees of freedom (or 'hotspots'), transverse momentum scale, and fragmentation region profile. By analyzing the Δv_2 and $\Delta v_2/v_2$ ratio, our findings provide new constraints on the uncertainties of the QGP initial state and provide additional constraints for refining model parameters.

Primary author: Prof. JIANG, Ze-Fang (Hubei Engineering University)

Presenter: Prof. JIANG, Ze-Fang (Hubei Engineering University)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **27** Type: **Oral**

Early Thermalization in kenitic theory via sBBGKY

Sunday, 26 October 2025 14:25 (20 minutes)

The early thermalization puzzle—stemming from the unexpectedly early success of hydrodynamics in describing the quark–gluon plasma (QGP)—remains a central open question in relativistic heavy-ion collisions. To address this, **we develop a new theoretical framework, the spectral BBGKY hierarchy**, which is analytically equivalent to the Liouville equation and preserves time-reversal invariance while offering significant advantages for numerical implementation. **This reformulation provides a semi-analytic route to non-equilibrium, nonlinear many-body dynamics, encompassing both the conventional Boltzmann description and explicit two-body correlations** [1].
Applying this spectral nonlinear Boltzmann equation to a homogeneous massless system, we systematically investigated the timescales of linearization and thermalization. We identified a robust separation: the linearization time, at which the system begins to follow hydrodynamical evolution, is approximately half the thermalization time. **This result provides a quantitative resolution to the early thermalization puzzle by demonstrating that hydrodynamic applicability commences once the system enters the linearized regime, well before full local thermal equilibrium is established**. [2]

[1] arXiv: 2507.14243, Xingjian Lu, Shuzhe Shi.

[2] arXiv: 2509.xxxxx, Xingjian Lu, Shuzhe Shi.

Primary author: LU, Shuai

Co-author: SHI, Shuzhe (Tsinghua University)

Presenter: LU, Shuai

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **28** Type: **Oral**

On possible implications of the exponential distribution of constituent quarks within proton at high energies

Monday, 27 October 2025 10:30 (20 minutes)

The differential cross section of the diffractive vector meson production in electron proton deeply inelastic scattering is considered to be one of the most promising observables to probe the spatial structure of the proton and the QCD dynamics in the high energy limit. In this work, we investigate the dependence of the differential cross section of vector meson production on the position distribution of the constituent quarks on top of the hot spot model. We consider two types of distribution functions, Gaussian and exponential, and include them into the dipole-proton scattering amplitude which is a key ingredient of the
vector meson production cross section. We calculate the cross sections for the production of J/Ψ mesons as function of the center of mass energy (W) and momentum transfer (|t|), respectively. At low |t| (|t| < 1.0 GeVˆ2), the coherent cross sections calculated with both Gaussian and exponential position distributions of the constituent quarks give similarly good description of the J/Ψ production data at HERA. However, we find that at relative large |t| (|t| > 1.0 GeVˆ2
) the coherent cross sections calculated with Gaussian position distribution function cannot describe the HERA data, while the coherent cross sections
computed with exponential position distribution function are in good agreement with the HERA data. This outcome indicates that the position of the constituent quarks in the proton may obey the exponential distribution, and the coherent process can be as a probe to resolve the position distribution of the constituent quarks. Moreover, our calculations show that the description of the coherent cross section of J/Ψ production remains robust when modeling the constituent quark positions with exponential distribution, independent of the particular
distribution function selected for the hot spot density profiles.

Primary authors: Dr XIANG, Wenchang; Dr HU, Yuantuan; Dr CAI, Yanbing; Dr WANG, Mengliang; Prof. ZHOU, Daicui

Presenter: Dr XIANG, Wenchang

Session Classification: Parallel III

Track Classification: 核子结构 (nucleon structure)

Contribution ID: **29** Type: **Oral**

What neutron stars say about the properties of strong interaction

Sunday, 26 October 2025 08:45 (20 minutes)

The existence of neutron stars provide us with a challenge and a possibility to study strong interaction, too. At the center of neutron stars the densities can reach 6-8 times the normal nuclear densities, and these densities cannot be studied in terrestrial experiments. Therefore, it provides us with constraints for the properties of the cold, dense strongly interacting matter.
The existence of quark matter inside the heaviest neutron stars has been the topic of numerous recent studies, many of them suggesting that a phase transition to strongly interacting conformal matter inside neutron stars is feasible. Here we examine this hybrid star scenario using a soft and a stiff hadronic model, a constituent quark model with three quark flavours, and applying a smooth crossover transition between the two. Within a Bayesian framework, we study the effect of up-to-date constraints from neutron star observations on the equation-of-state parameters and various neutron star observables. We find, consistently with other studies, that a peak in the speed of sound, exceeding 1/3, is highly favoured by astrophysical measurements.

Primary authors: Prof. SCHAFFNER-BIELICH, Jürgen (Institut für Theoretische Physik, Goethe Universität Frankfurt); WOLF, György (Wigner RCP); Dr TAKÁTSY, János (Wigner RCP); Dr KOVÁCS, Péter (Wigner RCP)

Presenter: WOLF, György (Wigner RCP)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **33** Type: **Oral**

粲偶素和奇特强子的蒙特卡洛模拟探究

Sunday, 26 October 2025 15:05 (20 minutes)

In this talk, I will introduce our recent work on the productions of charmonium and exotic hadrons in pp collisions at the LHC energies as well as in e^+e^- collisions at the BESIII energy using the PACIAE model.

Primary author: ZHANG, Wenchao (陕西师范大学)

Co-authors: Mr ZHANG, Jinpeng; Mr CAO, Jian; Dr SHE, Zhi-Lei; Dr LEI, An-Kei; Prof. ZHOU, Dai-Mei; Prof. SA , Ben-Hao; Prof. YAN, Yu-Liang; Prof. ZHENG, Hua

Presenter: ZHANG, Wenchao (陕西师范大学)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **34** Type: **Oral**

Perturbative and non-perturbative interaction between heavy quarks and a plasma of quasi quarks and gluons.

Monday, 27 October 2025 09:40 (20 minutes)

Both ALICE and CMS collaboration report precision measurements of nuclear suppression and collective flow of heavy flavor hadrons at low and intermediate transverse momentum region in PbPb collisions, which drives the theoretical development of the non-perturbative scatterings between heavy quarks and QGP medium. Aim at this, we have improved the LBT model by re-evaluating the heavy quark scattering rates including both perturbative Yukawa and non-perturbative color confining interactions between heavy quarks and thermal partons inside the QGP. In this work, we further incorporate the non-perturbative dynamics of the QGP system by modeling the QGP as a collection of thermalized quasi-particles, and the thermal masses of quasi-particles are related to the screening mass parameter m_d of Yukawa potential. We have fitted the thermal masses of quasi-particles through a Bayesian calibration on the lattice QCD equation of state. By combining this updated model with the (3+1)-dimensional hydrodynamic model CLVisc and a fragmentation-coalescence model for heavy quark hadronization, we achieve a simultaneous description of experimental data on the nuclear modification factor R_{AA} and elliptic flow v_2 of D mesons. We also explore the effects of the improved non-perturbative scatterings between heavy quarks and QGP medium on the key transport properties, such as the diffusion coefficient D_s. This also can provide another comparison to the latest results of D_s from lattice QCD calculation.

Primary author: Dr SUN, YaNan (Central China Normal University)

Co-authors: QIN, GuangYou (CCNU); XING, WenJing

Presenter: Dr SUN, YaNan (Central China Normal University)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **35** Type: **Oral**

Bayesian inference of the magnetic field and chemical potential on holographic jet quenching in heavy-ion collisions

Sunday, 26 October 2025 17:35 (20 minutes)

Jet quenching is studied in a background magnetic field and a finite baryon chemical potential. The production of energetic partons is calculated using the next-to-leading order (NLO) perturbative Quantum Chromodynamics (pQCD) parton model, while the parton energy loss formula is obtained from the AdS/CFT correspondence incorporating the magnetic field and baryon chemical potential effects. Using Bayesian inference, we systemically compare the theoretical calculations with experimental data for the nuclear modification factor R_{AA} of the large transverse momentum hadrons in different centralities of nucleus-nucleus collisions at 0.2, 2.76 and 5.02 TeV, respectively. The form of the holographic calculation leads to a strong negative correlation between the magnetic field and the chemical potential for a fixed amount of energy loss. This degeneracy can also be observed after the model calibration. Finally, we discussed the sensitivity of jet quenching phenomena to the enteral magnetic field and a background baryon chemical potential.

Primary author: ZHU, Liqiang (Central China Normal University)

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Presenter: ZHU, Liqiang (Central China Normal University)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **40** Type: **Oral**

Investigating U238 Deformation via Dilepton Production in Relativistic Heavy-Ion Collisions

Sunday, 26 October 2025 11:40 (20 minutes)

Due to their weak coupling to the strongly interacting matter produced in relativistic heavy-ion collisions, dileptons serve as a sensitive probe of the initial geometry of the colliding nuclei. In this study, we investigate the influence of initial nuclear quadrupole deformation, characterized by the parameter β2, on dilepton production in U+U collisions at √sNN = 193 GeV. The analysis is carried out using a modified multiphase transport model in which partonic interactions are described by the Nambu–Jona-Lasinio model. We observe a clear linear dependence of dilepton yields on β2 in both the low-mass region (LMR, < 1 GeV/c2) and intermediate-mass region (IMR, 1–3 GeV/c2) of the dilepton spectrum for the most central collisions. Also, dilepton production in the IMR region exhibits a stronger sensitivity to nuclear deformation than in the LMR, reflecting the dominance of earlier partonic processes in this mass range. These results suggest that precise measurements of dilepton yields in relativistic heavy-ion collisions can provide a viable means to determine the deformation parameter β2 of 238U.

Primary authors: ZHOU, Wenhao (Xihang University); LIU, Lu-Meng (Fudan University); 徐, 骏 (同济大学); SUN, KaiJia (Institute of Modern Physics, Fudan University)

Presenter: ZHOU, Wenhao (Xihang University)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **42** Type: **Oral**

Measurement of Charge Symmetry Breaking in A = 4 hypernuclei in 3GeV Au+Au collisions at RHIC

Monday, 27 October 2025 10:50 (20 minutes)

The Λ binding energy difference, which is called the charge symmetry breaking in the ground states of a pair of A = 4 hypernuclei, ^{4}H and ^{4}He, was measured to be $\Delta B^4_\Lambda(0^+_{g.s.}) \approx 350$ keV in nuclear emulsion experiments in the 1970s. In the 2015 and 2016 experiments from J-PARC and A1 collaboration, the binding energy difference in excited states was found to be much smaller than that in the ground states. These results are difficult to reproduce in existing theoretical models. The full understanding of the charge symmetry breaking in A = 4 hypernuclei still remains an open question.

As a part of the STAR fixed target program, the STAR detector collected data in Au+Au collisions at $\sqrt{s_{NN}} = 3$ GeV. The high production yield of hypernuclei provides an opportunity to measure the Λ binding energies of both A = 4 hypernuclei in ground states in the same experiment to address this charge symmetry breaking puzzle. In 2022, STAR published the measurements of the Λ binding energies of ^{4}H and ^{4}He with the data taken in 2018. The result showed that $\Delta B^4_\Lambda(1^+_{exc}) = -\Delta B^4_\Lambda(0^+_{g.s.}) = -0.16 \pm 0.14(\text{stat.}) \pm 0.12(\text{syst.})$ MeV. However the statistical uncertainties were large. STAR has taken about 2 billion events in Au+Au collisions at $\sqrt{s_{NN}} = 3$ GeV in the run 2021, which allows us to improve this measurement.

In this talk, we will present the improved measurement of the charge symmetry breaking in A = 4 hypernuclei in Au+Au collisions at $\sqrt{s_{NN}} = 3$ GeV with 2021 data. The signal reconstructions and binding energy measurements of ^{4}H and ^{4}He, including corrections and systematic uncertainty evaluations, will be discussed. The new results show about factor of 3 reduction in statistical uncertainties. These results will be compared to previous measurements and theoretical models.

Primary author: Dr 邵, 天浩 (复旦大学)

Presenter: Dr 邵, 天浩 (复旦大学)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **47** Type: **Oral**

Analytical Solution and Lie Algebra of Relativistic Boltzmann Equation

Sunday, 26 October 2025 14:00 (25 minutes)

In this talk, based on the problem and physics-oriented approach, combined with our knowledge of relativistic kinetic theory, we present for the first time the invariant Lie algebra admitted by the relativistic Boltzmann equation, from which the group invariant transformations can be constructed. As the immediate application of this Lie algebra, we demonstrate that in the case of hard sphere interaction, the relativistic BKW (Bobylev, Krook and Wu) solution —constructed here in a more straightforward manner —can be mapped onto an expanding solution in FLRW spacetime given by \cite{Bazow:2016} using moment method. Furthermore, we show that this mapping can be generalized to a broader class of cases where the cross-section respects a scale transformation $\sigma \to \lambda^{\alpha}\sigma$, under momentum scaling $p \to \lambda p$. Consequently, solving the Boltzmann equation in an expanding background becomes unnecessary; one may solve the simpler Minkowski-space problem and apply the symmetry map.

Primary authors: HU, Jin (Fuzhou University); ZHAO, Xuan (Tsinghua University); WANG , Yi (Tsinghua University); XU, Zhe (Tsinghua University)

Presenter: HU, Jin (Fuzhou University)

Session Classification: Parallel III, Invited Talk

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **48** Type: **Oral**

Anisotropic Hydrodynamics Expands the Domain of Applicability of Hydrodynamics

Monday, 27 October 2025 09:40 (20 minutes)

We perform 2+1D simulations of anisotropic hydrodynamics (aHydro) under boost-invariant and conformal conditions. Comparing both aHydro and traditional hydrodynamics to kinetic theory in the relaxation-time approximation as the underlying microscopic theory, we show that aHydro provides a superior description of the evolution across a wide range of opacity, effectively extending
the boundaries of the applicability of hydrodynamic modelling. Our results demonstrate aHydro's
potential for describing collective flow in small systems where traditional hydrodynamics faces chal-
lenges

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Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **55** Type: **Oral**

Bubble nucleation and gravitational waves from cosmological chiral phase transitions in soft-wall AdS/QCD

Monday, 27 October 2025 10:50 (20 minutes)

We study the first-order phase transition in holographic QCD models with two-flavor and 2+1-flavor matter at finite temperature and chemical potential. Using the holographic bounce solution, we calculate the key parameters governing phase transition dynamics, including the strength parameter α, the inverse duration time β/H_*, and the bubble wall velocity v_w. Along the phase transition line in the QCD phase diagram, we find that the bubble wall velocity v_w increases as the temperature decreases, while the inverse duration time β/H decreases and the strength parameter α grows. This behavior indicates that the transition becomes stronger and lasts longer at lower temperatures and higher chemical potentials. Our results suggest that the bubble expansion remains in the deflagration regime, with v_w staying below the sound speed ($c_s = 1/\sqrt{3}$). The gravitational wave signal from the QCD phase transition at finite temperature and density could provide a potential explanation for the recent NANOGrav 15-year dataset.

Primary author: CHEN, Yidian (Hangzhou Normal University)

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Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **56** Type: **Oral**

Orbital dynamics in magnetovortical matter

Sunday, 26 October 2025 11:20 (20 minutes)

We discuss Dirac fermions under the coexistent rotation and strong magnetic field called the magnetovortical matter. The partition function for this system is constructed based on thermodynamic stability and gauge invariance [1]. We show that the orbital contribution to bulk thermodynamics dominates over the conventional contribution from anomaly-related spin effects found in Ref. [2]. This orbital dominance manifests itself in the sign inversion of the induced charge and current, and can be tested experimentally as the flip of the angular momentum polarization when the magnetic field strength is increased.

[1] Kenji Fukushima, Koichi Hattori, Kazuya Mameda, Phys.Rev.Lett. 135 (2025) 1, 011601 [2409.18652 [hep-ph]]
[2] Koichi Hattori, Yi Yin, Phys.Rev.Lett. 117 (2016) 15, 152002 [1607.01513 [hep-th]]

Primary authors: MAMEDA, Kazuya (Tokyo University of Science); HATTORI, Koichi (Zhejiang University); FUKUSHIMA, Kenji (Univeristy of Tokyo)

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Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **57** Type: **Oral**

The CEP of QCD Matter Acts as a Thermalization Point

Monday, 27 October 2025 11:10 (20 minutes)

The critical endpoint (CEP) in the quantum chromodynamics (QCD) phase diagram may act as a thermalization point, drawing non-equilibrium systems toward thermodynamic equilibrium. Using transport and gap equations from the NJL model, we show that QCD matter perturbed by velocity fields near the first-order phase transition line evolves toward the CEP. Simulations confirm this attractor behavior: systems near the CEP return to it after perturbations, and those along the phase boundary converge toward it.

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Presenter: HUANG, anping (Tsinghua University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **58** Type: **Oral**

Optimal Observables for the Chiral Magnetic Effect from Machine Learning

Sunday, 26 October 2025 11:40 (20 minutes)

The detection of the Chiral Magnetic Effect (CME) in relativistic heavy-ion collisions remains challenging due to substantial background contributions that obscure the expected signal. In this Letter, we present a novel machine learning approach for constructing optimized observables that significantly enhance CME detection capabilities. By parameterizing generic observables constructed from flow harmonics and optimizing them to maximize the signal-to-background ratio, we systematically develop CME-sensitive measures that outperform conventional methods. Using simulated data from the Anomalous Viscous Fluid Dynamics framework, our machine learning observables demonstrate up to 90\% higher sensitivity to CME signals compared to traditional γ and δ correlators, while maintaining minimal background contamination. The constructed observables provide physical insight into optimal CME detection strategies, and offer a promising path forward for experimental searches of CME at RHIC and the LHC.

Primary authors: Prof. KHARZEEV, Dmitri ({Center for Nuclear Theory, Department of Physics and Astronomy); Prof. IKEDA, Kazuki (Department of Physics, University of Massachusetts Boston); Prof. HIRONO, Yuji (Institute of Systems and Information Engineering, University of Tsukuba); Mr 刘, 梓谊 (清华大学物理系); Prof. 施, 舒哲 (Department of Physics, Tsinghua University)

Presenter: Mr 刘, 梓谊 (清华大学物理系)

Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **59** Type: **Oral**

Collective flow measurements in OO and NeNe collisions with CMS

Sunday, 26 October 2025 12:00 (20 minutes)

Measurements of collective flow in intermediate size collisions such as OO and NeNe are crucial for understanding the origin of collectivity in small systems and its evolution with collision system size. Furthermore, they are crucial for probing the possible exotic nuclear structure of the nucleus. With data collected by the CMS experiment at the LHC, charged particles v_n(n=2,3) are reported in OO and NeNe collisions using two- and multiple-particle correlations as functions of centrality. The results are compared with pp, pPb, and PbPb collisions as well as theoretical calculations to provide new insights into the origin of collectivity in small systems and nuclear structure of O and Ne nucleus.

Primary authors: 彭, 佳腾 (复旦大学); 陈, 震宇 (山东大学)

Presenter: 彭, 佳腾 (复旦大学)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **64** Type: **Oral**

Study of the Deconfinement Phase Transition under real rotation with Matrix model

Monday, 27 October 2025 09:00 (20 minutes)

We constructed the matrix model under real rotation ω in a cylinder of radius R, with $R\omega < 1$ to preserve causality, by using the background field effective theory. Based on this new matrix model, we investigated the confinement/deconfinement phase transition in $SU(3)$ and $SU(2)$ gauge theories. Our results indicate that a phase transition can occur as long as the non-perturbative contribution of the matrix model is taken into account. The rotating gluon plasma transforms into an inhomogeneous medium, and the phase transition temperature T_c decreases as the distance from the rotation axis increases; T_c remains almost unaffected by ω around the rotation axis particular for $SU(3)$. On the other hand, T_c first increases and then decreases with increasing ω when considering the schematic rotation-dependent coupling constant, which is due to the competition between the coupling constant and the semi-classical gluon vacuum and Gaussian fluctuations induced by rotation. In addition, our results show that phase transition always remains first-order for $SU(N)$ theory with $N \geq 3$, and second-order for $SU(2)$ theory.

Primary author: DU, Qianqian (Guangxi Normal University)

Co-authors: Prof. GUO, Yun (Guangxi Normal University); Prof. HUANG, Mei (University of Chinese Academy of Sciences); Prof. JIANG, Yin (Beihang University)

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Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **67** Type: **Oral**

Chiral and spin effects in global equilibrium by quantum kinetic theory

Sunday, 26 October 2025 11:00 (20 minutes)

In this talk, we demonstrate how quantum kinetic theory governs chiral and spin effects in global equilibrium. By extending the framework from constant to varying electromagnetic fields, we show that previously undetermined chiral and spin effects induced by vorticity and electromagnetic fields can now be further pinned down.

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Presenter: 高, 建华 (山东大学（威海）)

Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **69** Type: **Oral**

Flow simulation at 500 MeV/u U+U in CEE experiment

Sunday, 26 October 2025 09:05 (20 minutes)

The Cooling-Storage-Ring External-target Experiment (CEE) at Heavy Ion Research Facility in Lanzhou (HIRFL) is designed to study the properties of nuclear matter created in heavy-ion collisions at a few hundred MeV/u to 1 GeV/u beam energies, facilitating the research of quantum chromodynamics phase structure in the high-baryon-density region.
Collective flow is one of the most important observables in heavy-ion collision experiments to study the bulk behavior of the created matter.
Even though the standard event plane method has been widely used for collective flow measurements, it remains crucial to validate and optimize this method for the CEE spectrometer.
In this talk, we present the experimental procedures for event plane reconstruction and for measuring directed flow and elliptic flow in ^{238}U+^{238}U collisions at 500 MeV/u, with event planes reconstructed using both the Multi Wire Drift Chamber and the Zero Degree Calorimeter with and without magnet, respectively. At this energy, the elliptic flow may reach its minimum value.
Multiple event generators, such as IQMD, UrQMD, and JAM, are used to simulate events, and the detector response is modeled using the CEE Fast Simulation (CFS) package.

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Presenter: WU, wanlong (近物所)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **72** Type: **Oral**

Study of the Quark-Meson Model with Vector Mesons within Functional Renormalization Group

Monday, 27 October 2025 09:20 (20 minutes)

In this work, we propose an effective action for the quark-meson model incorporating all (pseudo)scalar and (axial)vector mesons based on chiral symmetry. Within the framework of the functional renormalization group (FRG), we conduct a systematic study of the model. By deriving and solving the flow equation for the effective potential, we calculate the curvature masses of mesons at finite temperature (T) and chemical potential (μ). The observed degeneracy between chiral partners at high T and μ provides clear evidence for chiral symmetry restoration.

Using the method of analytic continuation, we compute the in-medium spectral functions of the ρ meson across different phases. These results establish a foundation for future investigations of dilepton production in hot and dense QCD matter.

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Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **74** Type: **Oral**

elliptic flow coefficient of $D_{\rm S}$ as an evidence of heavy flavor sequential hadronization in HIC

Sunday, 26 October 2025 14:45 (20 minutes)

Within the framework of a Langevin dynamics model for heavy quarks in a hot and dense medium, combined with a sequential coalescence +fragmentation hadronization scenario which let the $D_{\rm s}$ meson produced earlier than the other hadron, we systematically calculate the Pb+Pb yield spectra of D_s, D^0, and Λ_c^+, the yield ratios D_s/D^0 and Λ_c^+/D^0, and their elliptic flow coefficient $v_2(p_{\rm T})$ as functions of transverse momentum $p_{\rm T}$. We find that incorporating sequential hadronization beyond hadronic-phase interactions induces an enhancement of the v_2 of D^0 and a suppression of v_2 of D_s, resulting in anomalously suppressed v_2 of D_s relative to D^0 in the intermediate p_T region. This signature is consistent with preliminary ALICE measurements reported at the Quark Matter conference; therefore, it provides key evidence of the sequential hadronization mechanism.

Primary authors: ZHANG, Ben-Wei (Central China Normal University); Dr ZHAO, Jiaxing (Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center for Heavy Ion Physics); DAI, Wei (China University of Geosciences); Ms XU, Zi-Xuan (Central China Normal University)

Presenters: DAI, Wei (China University of Geosciences); Ms XU, Zi-Xuan (Central China Normal University)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **78** Type: **Oral**

Investigating the beauty quark dynamics with the non-prompt charm hadron productions in high energy pp collisions at the LHC

Sunday, 26 October 2025 16:55 (20 minutes)

In high-energy proton-proton (pp) collisions at the LHC, non-prompt charm hadrons, originating from beauty hadron decays, provide a valuable probe for beauty quark dynamics, particularly at low transverse momentum (p_T) where direct beauty measurements are challenging. We employ the A Multi-Phase Transport (AMPT) model in its string-melting mode to simulate these processes in pp collisions at $\sqrt{s} = 13$ TeV. By tuning the beauty quark rest mass ($m_b = 6.6$ GeV) and the beauty-specific coalescence parameter ($r^b_{\rm BM} = 1.2$), we achieve improved agreement with experimental data on beauty hadron yields, baryon-to-meson ratios, and non-prompt charm hadron production from ALICE and LHCb. We present the transverse-momentum and multiplicity dependence of non-prompt to prompt charm-hadron ratios, providing new insights into the interplay between heavy-quark production and hadronization process. This study offers a quantitative baseline for future studies of heavy-quark transport and hadronization in small collision systems.

Primary author: 郑, 亮 (China University of Geosciences (Wuhan))

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Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **79** Type: **Oral**

Observation of Strong Collectivity for ϕ meson in High Baryon Density Region at RHIC

Monday, 27 October 2025 09:20 (20 minutes)

Directed flow v_1 has been used to probe early dynamics in high-energy nuclear collisions. The vector meson $\phi(s\bar{s})$, with a mass comparable to that of light baryons, exhibits a small interaction cross section with other hadrons. Therefore, the measurement of ϕ-meson directed flow v_1 provides clean access to the early collision dynamics and the production mechanisms of the vector-mesons.

In this talk, we report the measurement of ϕ-meson directed flow (v_1) from Au+Au collisions at center-of-mass energies of 3.0, 3.2, 3.5, 3.9 and 4.5 GeV, using data collected by the STAR experiment as part of the RHIC Beam Energy Scan program. In the high-baryon-density region, the observed ϕ-meson v_1 values are all positive and comparable to those of baryons (protons and Λ), while the v_1 values of lighter mesons, such as pions and kaons, are much smaller than those of ϕ mesons. The new results will be compared within the framework of hadronic transport model calculations (UrQMD and JAM), and the role of vector meson-baryon coupling in ϕ-meson production will be discussed.

Primary author: ZHENG, Guangyu (University of Chinese Academy of Sciences)

Presenter: ZHENG, Guangyu (University of Chinese Academy of Sciences)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **80** Type: **Oral**

Imaging nuclear modifications on parton distributions at the LHC and EicC/EIC

Monday, 27 October 2025 10:50 (20 minutes)

Nuclear modifications to parton distribution functions provide an essential baseline for disentangling final-state nuclear matter effects in high-energy nuclear collisions. However, determining the explicit form of the modification factors $r_i^{\mathrm{A}}(x, Q^2)$ through global analyses remains challenging, partly due to their complex relationships with observables. In this talk, we introduce a series of novel observables in pA collisions at the LHC, designed to establish an approximate mapping to the underlying nuclear modification factors $r_i^{\mathrm{A}}(x, Q^2)$. Specifically, by combining the reorganized cross sections of multiple processes, we separately purify signals from light-quark, gluon, and heavy-flavor (charm) distributions in nuclei. This approach allows us to effectively image the $r_i^{\mathrm{A}}(x, Q^2)$ for specific parton species, serving as an analogy to the measurement of nuclear modifications on structure functions in DIS. Such imaging observables are expected to significantly enhance the impact of LHC data by providing more direct constraints on designing the parametrization forms of flavor-separated nuclear modifications. Importantly, this approach can help establish a framework for analysis of the commonalities and distinctions in nuclear modification effects across diverse processes, spanning from LHC to EicC/EIC.

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Session Classification: Parallel III

Track Classification: 核子结构 (nucleon structure)

Contribution ID: **83** Type: **Oral**

Suppression of elliptic anisotropy inside jets: A new perspective for jet quenching

Sunday, 26 October 2025 17:15 (20 minutes)

Particle azimuthal anisotropies inside jets, defined within the momentum plane perpendicular to the jet axis, carry the information of the QCD cascade process for jet formation. In this work, we propose to measure the medium-induced modifications of the elliptic anisotropy inside jets in relativistic heavy-ion collisions to provide novel insight into the jet quenching phenomenon. By simulating the jet propagation in the hot and dense nuclear medium with a Linear Boltzmann Transport model, we observe a de-correlation in the two-particle azimuthal angular distribution for inclusive jet production in AA collisions relative to that in pp collisions, which results in significant suppression of the in-jet elliptic anisotropy coefficient v_2. This phenomenon arises from the stochastic and strong interactions with the thermal QGP medium undergone by the jet particles. Furthermore, the nuclear modifications of the in-jet v_2 are found to be sensitive to the medium properties in the model study, which provide a potential probe for the jet tomography of nuclear matter.

Primary authors: YANG, Mengquan (Central China Normal University); Mr RU, Peng (South China Normal University)

Co-authors: Mr KONG, WeiXi (Central China Normal University); Prof. ZHANG, Ben-Wei (Central China Normal University)

Presenters: YANG, Mengquan (Central China Normal University); Mr RU, Peng (South China Normal University)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **84** Type: **Oral**

Global Analyses of Collinear Fragmentation Functions from the NPC Collaboration

Monday, 27 October 2025 11:10 (20 minutes)

Fragmentation functions (FFs) are crucial non-perturbative inputs in quantum chromodynamics (QCD) for predicting hadron production cross sections in high-energy scattering processes. In this talk, we present recent progress on global fits of FFs by the Non-perturbative Physics Collaboration (NPC). Our analyses incorporate a comprehensive set of precision measurements, including data from the LHC, electron-positron collisions, and semi-inclusive deep inelastic scattering. We report results for both light charged and neutral hadrons, highlighting the improved constraints on FFs achieved through these global fits. Additionally, we discuss phenomenological applications of the extracted FFs and the theoretical framework developed in our work.

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Presenter: Dr SHEN, XiaoMin (Institute of Modern Physics (IMP), CAS)

Session Classification: Parallel III

Track Classification: 核子结构 (nucleon structure)

Contribution ID: **86** Type: **Oral**

Dynamical modeling the conserved baryon density with causality near the QCD critical point

Monday, 27 October 2025 08:40 (20 minutes)

Exploring the QCD phase transition is one of the most important goals in relativistic heavy-ion collisions. The Beam Energy Scan Program at RHIC has revealed a preliminary non-monotonic behavior of net-proton multiplicity fluctuations with increasing collision energy [1], which is consistent with theoretical predictions [2].

However, the quark-gluon plasma created in relativistic heavy-ion collisions is a highly complex system, and several factors can modify the signal of the QCD phase transition. Dynamical modeling near the QCD phase transition in a realistic experimental context is essential for the ultimate discovery of the QCD phase transition in heavy-ion collisions. Several dynamical models of conserved baryon density have been developed based on the assumption that only diffusive modes are relevant to the slow dynamics near the QCD critical point [3-5]. However, as pointed out by Hydro+ [6], critical slowing-down effects induce a quasi-diffusive mode, described by a relaxation timescale τ, which affects the evolution of dynamical fluctuations and ensures the causality of the diffusion process. By employing the deterministic equations of the non-Gaussian fluctuations dynamics of baryon density [7], we study the effects of the causality of diffusion near the QCD critical point [8]. We find that the relaxation effects induced by causality strongly enhance the fluctuations of the baryon density, as well as large oscillatory behavior, especially for fast modes. These effects are particularly significant for higher-order fluctuations of baryon density. Consequently, further studies of the quasi-diffusion process in experimental measurements are essential for QCD critical point research.

[1] STAR Collaboration, arXiv: 2504.00817
[2] M.Stephanov, arXiv:2410.02861
[3] M.Sakaida, M.Asakawa, H.Fujii, M.Kitazawa, Phys.Rev.C 95 (2017) 064905
[4] G. Pihan, M.Bluhm, M.Kitazawa, T. Sami, M.Nahrgang, Phys.Rev.C 107 (2023) 014908,
[5] S.Wu, Phys.Rev.C 111 (2025) 014915
[6] M. Stephanov and Y. Yin, Phys. Rev. D 98, 036006 (2018)
[7] X. An, G. Bąsar, M. Stephanov, and H.-U. Yee, Phys. Rev. Lett. 127, 072301 (2021)
[8] N. Abbasi, X. An and S.Wu, in preparation

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Presenter: WU, Shanjin (Lanzhou University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **90** Type: **Oral**

Recent LHCb results on open charm and charmonium production

Monday, 27 October 2025 09:00 (20 minutes)

Heavy quark production in high-energy collisions is a sensitive probe of QCD and nuclear matter effects. Open heavy-flavor hadrons and quarkonium states provide complementary insights into initial-state effects, such as nuclear parton distribution modifications and parton energy loss, as well as final-state effects like medium interactions and possible Quark-Gluon Plasma (QGP) formation. Observations of QGP-like signatures in high-multiplicity small systems further motivate systematic studies across different collision systems.
In this contribution, we present recent LHCb results on open charm and quarkonium production in pp, pPb, and PbPb collisions. The measurements include various charm hadrons and quarkonium states, offering new constraints on heavy-quark production, hadronization, and medium effects. These results improve our understanding of QCD dynamics across system sizes.

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Presenter: 康, 有恩 (清华大学)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **91** Type: **Oral**

Flow measurements at LHCb experiment

Sunday, 26 October 2025 09:25 (20 minutes)

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. The LHCb experiment has the ability to study particle correlations in high-energy hadron collisions at forward rapidity, complementing the results from other experiments. It also has the unique fixed-target configuration at LHC, with various species of gas target available.
In this contribution, recent results on collective flow from the LHCb experiment will be discussed, aimed to study the hydrodynamics at forward regions and nuclear structure of the gas targets.

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Presenter: 王, 剑桥 (Tsinghua University)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **93** Type: **Oral**

Differentiating Energy-Energy Correlators with Charged Particle Multiplicities within a Jet

Sunday, 26 October 2025 15:25 (20 minutes)

Recent CMS results reveal that jets with extremely high multiplicity exhibit novel substructure patterns not seen in ordinary jets, including long-range correlations. However, standard Monte Carlo tools struggle to access this regime due to its rarity and complexity. In this work, we develop a theoretical framework to study high-multiplicity jets, incorporating both multiplicity evolution and Energy-Energy Correlators (EEC) as key probes of jet substructure. Using the normalized multiplicity ratio m=n/⟨n⟩, we investigate how jet properties evolve across multiplicity classes and compare our findings with Pythia8 simulations. This provides new insights into perturbative QCD dynamics in extreme jet events.

Primary authors: DUAN, Pi (CCNU); WANG, Lei (Shandong University); 柯 (KE), 伟尧 (Weiyao) (华中师范大学); QIN, Guang-You (Central China Normal University)

Presenter: DUAN, Pi (CCNU)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **94** Type: **Oral**

Measurement of $K^{*0,\pm}$ Mesons in Heavy-Ion Collisions at RHIC

Sunday, 26 October 2025 09:05 (20 minutes)

Neutral and charged vector mesons can exhibit sensitivity to isospin-violating phenomena arising from Landau level splitting when a strong magnetic field (B) is present in a QCD medium [1]. A possible case involves the neutral K^{*0} ($d\bar{s}$) and the charged K^{*+} ($u\bar{s}$), which are close in mass and share the same isospin, yet their constituent quarks possess different magnetic moments, differing by roughly a factor of five. Recent measurements by NA61/SHINE reporting isospin asymmetry between neutral and charged kaons challenge the conventional expectation of isospin symmetry in QCD, although the underlying origin of this effect remains unresolved [2] . If a B-field induces a yield difference between K^{*0} and $K^{*\pm}$, it could influence the inclusive kaon yields via feed-down channels ($K^{*0} \to K^{\pm} + \pi^{\mp}$, $K^{*\pm} \to K^{0}_{S} + \pi^{\pm}$).

In this presentation, we examine the invariant mass peak positions and widths, transverse momentum (p_T) spectra, yields (dN/dy), and average transverse momenta ($\langle p_T \rangle$) of $K^{*0,\pm}$ mesons at mid-rapidity. The analysis spans collisions involving isospin-asymmetric systems (Au+Au, Ru+Ru, Zr+Zr) and isospin-symmetric systems (O+O), alongside p+p collisions at $\sqrt{s_{NN}} = 200$ GeV. We present particle ratios such as $K^{*\pm}/K^{*0}$ and $K^{\pm}/K^{0}_{S}$ as functions of p_T and collision centrality across different systems. Results from p+p collisions, where magnetic field effects are expected to be negligible, provide a valuable baseline for comparison. Furthermore, we include results from the BES-II Au+Au dataset ($\sqrt{s_{NN}} = 7.7$–19.6 GeV) to explore the energy dependence of these ratios. These results will be compared to model calculations.

[1]. K. Xu et. al., Phys. Lett. B 809, 135706 (2020)
[2] H. Adhikary et. al, (NA61/SHINE collaboration), Nature Commun. 16, 2849 (2025)

Primary author: Prof. SINGHA, Subhash (Institute of Modern Physics CAS)

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Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **95** Type: **Oral**

Nuclear Clustering and Non-Equilibrium Dynamics in Small-System Collisions

Sunday, 26 October 2025 11:20 (20 minutes)

Understanding the impact of nuclear structure in high-energy nuclear collisions is critical to advancing our knowledge of quark-gluon plasma (QGP) formation. In this study, we investigate the role of nuclear clustering, in particular the alpha-cluster structure in ^{16}O, using anisotropic flow observations from ^{16}O $+^{16}$ O collisions at RHIC energy. Through systematic simulations with an improved AMPT model, we show that a longer effective hadron formation time is essential to match recent STAR experimental data. Importantly, the anisotropic flow coefficients serve as sensitive probes for distinguishing alpha-clustering configurations in ^{16}O nuclei [1].

Additionally, we extend this investigation to ^{20}Ne+^{20}Ne and ^{16}O+^{16}O collisions at LHC energies, where we compare the results from the AMPT transport model with those from hydrodynamic models. The AMPT model, which accurately simulates non-equilibrium dynamics, shows significant deviations from hydrodynamic predictions, especially in key observables such as elliptic flow v_2 , Pearson correlation coefficient $\rho(v_2^2\{2\}, \langle p_T \rangle)$, and , symmetric cumulants $\mathrm{SC}(3,2)$, and four-particle cumulant $c_2\{4\}$. These discrepancies underscore the limitations of hydrodynamics, which assumes local thermal equilibrium, in small systems.

The advantage of the transport model lies in its ability to capture the microscopic dynamics of particle collisions, making it more suitable for the study of small and intermediate collision systems such as ^{20}Ne $+^{20}$ Ne and ^{16}O $+^{16}$ O, where non-equilibrium effects are significant. Unlike hydrodynamic models that assume local thermal equilibrium, the AMPT model effectively describes partonic interactions in systems with fewer particles, providing a more accurate description of initial state fluctuations and parton escape dynamics.

These results underscore the importance of transport models in the study of the complex dynamics of small and medium-sized nuclear systems, providing critical insights into the influence of nuclear clustering and improving the understanding of QGP formation at RHIC and the LHC.

[1] X.L. Zhao, G.L. Ma, Y. Zhou, Z.W. Lin, and C. Zhang, arXiv:2404.09780.
[2] X.L. Zhao, P. Li, G.L. Ma, Y. Zhou, Z.W. Lin, and C. Zhang, preparing.

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Presenter: ZHAO, Xin-Li (University of Shanghai for Science and Technology)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **97** Type: **Oral**

Heavy quarkonium dissociation, regeneration and equilibration in the quark-gluon plasma

Sunday, 26 October 2025 16:15 (20 minutes)

We present a comprehensive investigation of the heavy quarkonium dynamics in the quark-gluon plasma (QGP), including the dissociation caused by dynamical scatterings off the medium partons and the regeneration from the unbound single heavy quarks. The dissociation cross sections and transition rates for both 2->2 leading-order (gluo-dissociation) and 2->3 next-to-leading order (partonic inelastic scattering) processes are calculated within the framework of second-order quantum mechanical perturbation theory [1], utilizing an effective color-electric dipole coupling of the quarkonium with thermal gluons. We then employ the microscopic transition amplitudes for these processes and simulate the kinetic and chemical equilibration for heavy quarkonium via transport in a static QGP box within the semi-classical Boltzmann equation approach [2], where the Boltzmann transport of heavy quarkonium is coupled to the single heavy quark diffusion simulated by Langevin equations in a real-time fashion. The pertinent equilibration time turns out to be comparable to the lifetime of the QGP created in the most central heavy-ion collisions at the LHC energies. This work paves the way for realistic phenomenological applications to heavy quarkonium transport.

References

[1] S. Zhao and M. He, Phys. Rev. D 110, no.7, 074040 (2024).

[2] S. Zhao and M. He, arXiv: 2508.11897 [hep-ph].

Primary authors: Prof. HE, Min (Nanjing University of Science & Technology); Mr ZHAO, Shouxing (Nanjing University of Science & Technology)

Presenter: Prof. HE, Min (Nanjing University of Science & Technology)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **98** Type: **Oral**

Functional renormalization group study of anomalous magnetic moment in a low energy effective theory

Sunday, 26 October 2025 11:20 (20 minutes)

The quark anomalous magnetic moments (AMMs) are investigated in a 2-flavor low-energy effective theory within the functional renormalization group (FRG) approach under an external magnetic field. The Schwinger formalism is adopted for quark propagators, and Fierz-complete four-quark scatterings are self-consistently included through the renormalization group flows. We find that the quark AMMs are dynamically generated with the chiral symmetry breaking, and the magnitude of the AMM of the down quark is around 4 times larger than that of the up quark. The transverse AMMs and the longitudinal d-quark AMM monotonically decrease with the magnetic field strength, while the longitudinal u-quark AMM slightly increases with the magnetic field strength. At B=0, the magnetic moments of proton and neutron are computed using the constituent quark model, which are close to the experimental values.

Primary authors: HUANG MEI, Mei (IHEP, CAS); 温, 睿 (UCAS); 黄, 闯 (大连理工大学)

Presenter: 温, 睿 (UCAS)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **99** Type: **Oral**

Strange Hadron Production in Au+Au Collisions from STAR Fixed-Target Experiment

Monday, 27 October 2025 11:30 (20 minutes)

Strange hadrons have been suggested as sensitive probes for the medium properties of the nuclear matter created in heavy-ion collisions. A dense baryon-rich medium is formed during collisions at center-of-mass energies of a few-GeV. Since strange hadrons are produced near or below the threshold, their phase space distribution and yield ratios may provide strong constraints on the equation of state (EoS) of high baryon density matter.

In this presentation, the recent results on strange hadron production in Au + Au collisions at $\sqrt{s_{\mathrm{NN}}}$ = 3.0, 3.2, 3.5, 3.9, 4.5, 5.2, 6.2 GeV with the fixed-target mode from the STAR experiment will be presented. The transverse momentum spectra (p_{T}), rapidity density distributions (dN/dy) of $\mathrm{K}^{\pm}$, $\mathrm{K}^{0}_{\mathrm{S}}$, ϕ, , $^{-}$ and their yield ratios $\Lambda/\mathrm{K}^{0}_{\mathrm{S}}$, $^{-}/$ will be presented as a function of centrality and collision energy. The $\Lambda/\mathrm{K}^{0}_{\mathrm{S}}$ enhancement hints at an onset of deconfinement in this energy range. We will also explore the centrality dependence of strange hadron yields and the evolution of their kinetic freeze-out temperature T_{Kin} and average radial expansion flow velocity $\langle\beta_{\mathrm{T}}\rangle$ extracted from the Blast-Wave model in the reported energy range, which can give insights on the EoS of the created medium. These results will be compared with those from higher collision energies and the physics implications will be studied by comparing to the thermal and transport model calculations.

Primary author: 李, 鸿灿 (Central China Normal University)

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Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **100** Type: **Oral**

A new pathway to probe the structure of nuclei from heavy to light

Sunday, 26 October 2025 11:00 (20 minutes)

The shape and orientation of colliding nuclei play a crucial role in determining the initial conditions of the quark-gluon plasma (QGP), which influence key observables such as anisotropic and radial flow. In this talk, we present the measurements of v_n, p_{T} fluctuation, and $v_n - p_{\mathrm{T}}$ correlations in isobar-like ^{238}U+^{238}U and ^{197}Au+^{197}Au collisions at $\sqrt{s_{\mathrm{NN}}} = 193$ and 200 GeV, respectively. Our results reveal prominent differences in these observables between the two systems, particularly in the most central collisions. Comparisons with hydrodynamic model calculations indicate a large quadrupole and octupole deformation in the ground states of ^{238}U nuclei, consistent with low-energy experiments. However, data also imply a small deviation from axial symmetry [1,2,3]. We also present the first measurements of v_n in ^{16}O+^{16}O collisions [4,5], providing insight into the impact of nucleon-nucleon correlations and further shedding light on the initial conditions of QGP droplets.

[1] STAR Collaboration, Nature 635, 67-72 (2024)
[2] STAR Collaboration, arXiv:2506.17785, Under ROPP review
[3] C. Zhang, J. Jia, J. Chen, C. Shen, L. Liu, arXiv:2504.15245
[4] STAR Collaboration, In preparation
[5] C. Zhang, J. Chen, G. Giacalone, S. Huang, J. Jia, Y.-G. Ma, PLB862, 139322(2025)

Primary authors: Prof. ZHANG, Chunjian (Fudan University); Prof. JIA, Jiangyong (Stony Brook University); Prof. CHEN, Jinhui (Fudan University); Prof. MA, Yugang (Fudan University)

Presenter: Prof. ZHANG, Chunjian (Fudan University)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **102** Type: **Oral**

Perturbative and non-perturbative properties of heavy quark transport in a thermal QCD medium

Monday, 27 October 2025 08:40 (20 minutes)

At leading order in QCD coupling constant, we compute the energy loss per traveling distance of a heavy quark dE/dz from elastic scattering off thermal quarks and gluons at a temperature T, including the thermal perturbative description of soft scatterings and a perturbative QCD-based calculation for hard collisions. We re-derive the analytic formula for dE/dz in the high-energy approximation, resulting in a logarithmic behavior from both the soft and hard contributions. The mass hierarchy is observed as $dE/dz(bottom) > dE/dz(charm)$ at a given velocity. Our full results are crucial for a better description of heavy quark transport in QCD medium, in particular at low and moderate transverse momentum.

Furthermore, we investigate the nonperturbative effects on the heavy quark transport in a semi-quark-gluon-plasma. The relevant results show that dE/dz is significantly suppressed due to a background field that is self-consistently generated in the effective theory. The comparisons with the results from the perturbative approach are implemented for both charm and bottom quarks. By utilizing the Langevin dynamics, we also perform the model-data comparisons at RHIC and LHC energies, in particular for the nuclear modification factor and flow coefficients of various heavy-flavor hadrons.

[1] Jiazhen Peng, et al., Unraveling the collisional energy loss of a heavy quark in a quark-gluon plasma, PhysRevD.109.096028 (2024)
[2] Shuang Li, et al., Langevin dynamics of heavy quarks in a soft-hard factorized approach, Eur. Phys. J. C 81, 536 (2021)
[3] Jiazhen Peng, et.al., Perturbative and non-perturbative properties of heavy quark transport in a thermal QCD medium, in preparing

Primary authors: LI, Shuang (China Three Gorges University); WANG, Sa (China Three Gorges University); SUN, Fei (CTGU); XIE, Wei (China Three Gorges University)

Presenter: LI, Shuang (China Three Gorges University)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **106** Type: **Oral**

Unveiling the jet angular broadening with photon-tagged jets in high-energy nuclear collisions

Sunday, 26 October 2025 14:25 (20 minutes)

The medium modification of jet substructure in hot and dense nuclear matter has garnered significant interest from the heavy-ion physics community in recent years. Measurements of inclusive jets show an angular narrowing in nucleus-nucleus collisions, while recent CMS results for photon-tagged jets (γ+jets) suggest evidence of broadening. In this study, we conduct a theoretical analysis of the angular structure of inclusive jets and γ+jets using a transport approach that accounts for jet energy loss and the medium response in the quark-gluon plasma. We examine the girth modification of γ+jets in $0-30\%$ PbPb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, achieving satisfactory agreement with recent CMS measurements. We explore the relationship between selection bias and jet kinematics by varying the threshold for $x_{j\gamma} = p_T^{\rm jet}/p_T^{\gamma}$. Notably, we quantitatively demonstrate that γ+jets significantly reduce selection bias and can effectively select jets that have been sufficiently quenched in PbPb collisions, which is crucial for capture the jet angular broadening. Additionally, we estimate the contributions of medium-induced gluon radiation and the medium response to the broadening of the jet angular substructure. Lastly, we analyze the modification patterns of jet R_g and $\Delta R_{\rm axis}$ in PbPb collisions, which indicate slight broadening for γ+jets and noticeable narrowing for inclusive jets compared to pp collisions.

Primary authors: Dr WANG, Sa (China Three Gorges University); Dr LI, Yao (Central China Normal University); Dr KANG, Jinwen (Central China Normal University); Prof. ZHANG, Ben-Wei (Central China Normal University)

Presenter: Dr WANG, Sa (China Three Gorges University)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **111** Type: **Oral**

Free Energy Structure and Relaxation Characteristics Near the First-Order Phase transition Line

Sunday, 26 October 2025 17:35 (20 minutes)

Using the three-dimensional kinetic Ising model with Metropolis algorithm, we calculate the free energy in the whole phase boundary, particularly near the first phase transition line (1st-PTL). The results show that along the 1st-PTL, as the temperature decreases, the energy barrier between the two coexisting phases diverges. This results in more difficulty to reach the equilibrium, i.e., ultra-slow relaxation, which has been recently demonstrated [1]. Meanwhile, we exam the randomness of the equilibrium time. It is found that near the 1st-PTL the equilibrium time is self-diverging, in contrast to the non-self-averaging near the critical point.
[1]. Xiaobing Li, Ranran Guo, Mingmei Xu etl al., Phys. Rev. E 111, 064115 (2025).

Primary authors: 郭, 冉冉 (ccnu); Prof. 吴, 元芳 (华中师范大学); Dr 李, 笑冰 (湖北文理学院); Prof. 许, 明梅 (华中师范大学)

Presenter: 郭, 冉冉 (ccnu)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **117** Type: **Oral**

Energy dependence of transverse momentum fluctuations in Au+Au collisions from a multiphase transport model

Sunday, 26 October 2025 16:35 (20 minutes)

Event-by-event mean transverse momentum fluctuations (<ΔT>) serve as a sensitive probe of initial state overlap geometry and energy density fluctuations in relativistic heavy-ion collisions. We present a systematic investigation of <ΔT> fluctuations in Au+Au collisions at 3.0–19.6 GeV, examining their centrality and energy dependence with the framework of an improved multiphase transport (AMPT) model. The centrality dependence of the ΔT cumulants up to fourth order deviates significantly from simple powering-law scaling.
Scaled cumulants are performed, with variances aligning well with the trends observed in the experimental data. Employing a two-subevent method, short-range correlations are slightly suppressed compared to the standard approach. Furthermore, baryons exhibit more pronounced <ΔT> fluctuations than mesons, potentially attributable to the effect of radial flow. These results provide referenced insights into the role of initial state fluctuations across different energies in heavy-ion collisions.
Please see the details using the DOI: https://doi.org/10.1103/PhysRevC.111.024911.

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Presenter: Dr 张, 留耀 (河南省科学院核科学与技术研究所)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **120** Type: **Oral**

Inverse magnetic catalysis and energy loss in a holographic QCD model

Monday, 27 October 2025 11:30 (20 minutes)

In this paper, we consider the Einstein-Maxwell-dilaton holographic model for light quarks with nonzero magnetic field and chemical potential. First, we study the phase diagrams in $T-\mu$ and $T-B$ planes. We observe inverse magnetic catalysis which is consistent with the lattice QCD results. We discuss the influence of the magnetic field and chemical potential on the location of the critical end point (CEP). It is found that the magnetic field increases the critical μ_{CEP} of the CEP in the $T-\mu$ plane and the chemical potential increases the critical B_{CEP} of the CEP in the $T-B$ plane. Second, we discuss the equations of state (EOS) with nonzero magnetic field and chemical potential. We observe that the EOS near the phase transition temperature are nonmonotonic. Then we study the energy loss with a nonzero magnetic field and chemical potential. It is found that the drag force of the heavy quark and jet quenching parameter $\hat{q}$ show an enhancement near the phase transition temperature. The peak values of drag force and $\hat{q}$ are pushed toward lower temperature with increasing B or μ. This phenomenon is consistent with the phase transition temperature decrease with increasing B or μ in this holographic model. Moreover, we find that the heavy quark may lose more energy when it is perpendicular to a magnetic field which is consistent with the results of the jet quenching parameter.

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Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **122** Type: **Oral**

Baryon electric charge correlation as a magnetometer of QCD

Monday, 27 October 2025 11:50 (20 minutes)

We present the first lattice QCD results of quadratic fluctuations and correlations of conserved charges in (2+1)-flavor lattice QCD in the presence of a background magnetic field. The simulations were performed using the Highly Improved Staggered Quarks with physical pion mass m_π = 135 MeV on $N_\tau = 8$ and 12 lattices. We find that the correlation between net baryon number and electric charge, denoted as χ_{11}^{BQ}, can serve as a magnetometer of QCD. At pseudocritical temperatures the χ_{11}^{BQ} starts to increase rapidly with magnetic field strength $eB > 2M_\pi^2$ and by a factor 2 at $eB \simeq 8M_\pi^2$.

By comparing with the hadron resonance gas model, we find that the eB dependence of χ_{11}^{BQ} is mainly due to the doubly charged $\Delta(1232)$ baryon. Although the doubly charged $\Delta(1232)$ could not be detected experimentally, the proxy constructed from its decay products, protons and pions, retain the eB dependence of $\Delta(1232)$' s contribution to χ_{11}^{BQ}. Additionally, under the same kinematic cuts as in the ALICE experiment, the proxy for χ_{11}^{BQ} still exhibits a strong dependence on the magnetic field.

Furthermore, the ratio of electric charge chemical potential to baryon chemical potential, $\mu_{\mathrm{Q}}/\mu_{\mathrm{B}}$, shows significant dependence on the magnetic field strength and varies with the ratio of electric charge to baryon number in the colliding nuclei in heavy ion collisions. These results provide baselines for effective theory and model studies, and both χ_{11}^{BQ} and $\mu_{\mathrm{Q}}/\mu_{\mathrm{B}}$ could be useful probes for the detection of magnetic fields in relativistic heavy ion collision experiments as compared with corresponding results from the hadron resonance gas model.

Primary authors: KUMAR, Arpith (Central China Normal University); DING, Heng-Tong (Central China Normal University); GU, Jin-Biao (Central China Normal University); LI, Sheng-Tai (Central China Normal University)

Presenter: GU, Jin-Biao (Central China Normal University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **124** Type: **Oral**

Moat regimes within a 2 + 1 flavor Polyakov-quark-meson model

Sunday, 26 October 2025 11:00 (20 minutes)

To better understand recent predictions on the moat regime of quantum chromodynamics (QCD) matter, this paper extends the previous work within the two-flavor quark-meson (QM) model to the more realistic 2+1 flavor Polyakov-quark-meson (PQM) model. Mainly, two effects are further taken into account: strange quark and confinement coded through Polyakov loop. Model parameters are chosen to consistently reproduce the pseudocritical temperature from lattice QCD, TC ~ 156 MeV, and the baryon chemical potential at the critical end point (CEP) from FRG-QCD, μB(CEP) ~635 MeV. It is found that the basic features of moat regimes for σ and π mesons remain similar to those from QM model: Moat regimes cover the region where temperature or baryon chemical potential is large; reentrances occur around the critical baryon chemical potential of chiral transition at zero temperature. Thus, the FRG-QCD results can still not be well understood, especially why the extrapolated CEP should be consistent with the boundaries of moat regimes for σ and π mesons. Nevertheless, some basic features can be understood qualitatively, and it is consistent that the pole energies are increasing functions of momenta in the whole T − μB plane. The moat regime and pole energy of K mesons are also studied with the features similar.

Primary author: 曹, 高清 (Sen Yat-sen University)

Presenter: 曹, 高清 (Sen Yat-sen University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **126** Type: **Oral**

Extract the speed of sound in the presence of quantum fluctuations

Sunday, 26 October 2025 14:45 (20 minutes)

The thermalization of quark-gluon plasma created in heavy-ion collisions is crucial for understanding its behavior as a relativistic fluid and the thermodynamic properties of the Quantum Chromodynamics (QCD). This study investigates the role of fluctuations in the relationship between transverse momentum and particle multiplicity, with a particular focus on their impact on extracting the QCD speed of sound. In a thermalized quark-gluon plasma, sources of
these fluctuations mostly originate from quantum fluctuations
at the level of the colliding nuclei, which as a consequence of independence of thermodynamic response follow a Gaussian distribution.}
In contrast, non-thermalized systems display non-Gaussian fluctuations, reflecting the breakdown of thermalization. By leveraging the Gaussianity condition of quantum-initiated fluctuations, the physical value of the speed of sound can be extracted statistically, even in the presence of significant event-by-event fluctuations. This framework provides a robust diagnostic tool for probing thermalization and extracting thermodynamic properties in both large and small collision systems.

Primary authors: SUN, Jing-An; YAN, Li (Fudan University); HUANG, Xu-Guang (Fudan Universiuty); MU, Yushan (Fudan)

Presenter: MU, Yushan (Fudan)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **127** Type: **Oral**

Measurement of Quarkonium Production and Polarization in Heavy-Ion Collisions

Sunday, 26 October 2025 16:35 (20 minutes)

Quarkonium production provides a powerful probe of the deconfinement of strongly interacting matter in high-energy heavy-ion collisions. Because the binding potential of heavy quark–antiquark pairs is screened in the quark–gluon plasma (QGP), measurements of quarkonium yields and polarization can reveal the onset and properties of this deconfined medium. For the J/ψ meson, a bound state of a charm quark and antiquark, (re-)generation during the QGP evolution is established as the dominant production mechanism at low transverse momentum (p_{T}) and in central Pb–Pb collisions at LHC energies. This regeneration process serves as a direct probe of charm-quark deconfinement and the degree of thermalization in the QGP.

In this talk, we present comprehensive measurements of the J/ψ nuclear modification factor R_{AA} in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV. Furthermore, new results on J/ψ polarization in heavy-ion collisions will be discussed, providing an additional handle on the quarkonium production mechanism and possible modifications of spin alignment in the QGP. All results are compared with state-of-the-art theoretical model calculations to constrain quarkonium production dynamics and to characterize the properties of the deconfined medium.

Primary author: BAI, Xiaozhi (University of Science and Technology of China)

Presenter: BAI, Xiaozhi (University of Science and Technology of China)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **129** Type: **Oral**

Multiplicity distributions in QCD jets and jet topics

Sunday, 26 October 2025 15:05 (20 minutes)

We present a comprehensive study of multiplicity distributions in QCD jets at the LHC. Our analysis combines pQCD calculations within the Double Logarithmic Approximation (DLA) and modified DLA (MDLA), together with comparisons to ATLAS data and PYTHIA simulations. We provide the first direct verification of KNO scaling for both quark- and gluon-initiated jets within the DLA framework by computing parton multiplicity distributions across the LHC p_T range. By incorporating energy conservation, the MDLA yields scaling functions that differ significantly from the pure DLA predictions. The MDLA framework provides a quantitatively accurate description of the inclusive charged-particle multiplicity distributions of the two leading jets in pp collisions at $\sqrt{s} = 13$ TeV, as measured by ATLAS over the range of p_T from 0.1 to 2.5 TeV, and shows good agreement with PYTHIA simulations. These findings are further supported by comparisons with quark- and gluon-initiated jet distributions obtained through jet topic modeling. The multiplicity distributions of quark and gluon jets, obtained by applying the method to ATLAS jet samples, are consistent with our MDLA predictions.
[1] X.-P. Duan, L. Chen, G.-L. Ma, C. A. Salgado, and B. Wu, arXiv:2503.24200.
[2] X.-P. Duan, L. Chen, G.-L. Ma, C. A. Salgado, and B. Wu, arXiv:2509.06158.

Primary authors: Ms DUAN, Xiang-Pan (Fudan University); Dr CHEN, Lin; MA, Guo-Liang (Fudan University); Prof. SALGADO, Carlos A.; Prof. WU, Bin

Presenter: Ms DUAN, Xiang-Pan (Fudan University)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **132** Type: **Oral**

Final-State effects on higher-order fluctuations of the mean transverse momentum at the LHC

Sunday, 26 October 2025 12:00 (20 minutes)

The ALICE collaboration published the first measurement of the skewness and kurtosis of mean pT fluctuations, which can constrain the initial state of ultra-relativistic nuclear collisions. In this paper, we investigate the higher-order mean pT fluctuations using a multiphase transport model for three different collision systems: pp collision at 5.02 TeV, Pb+Pb collision at 5.02 TeV and Xe+Xe collision at 5.44 TeV. We find that the AMPT model provides a reasonable description of the standard skewness, intensive skewness and kurtosis as a function of system size for all three systems. Moreover, AMPT model reproduces the non-monotonic trends of intensive skewness as observed in the experimental data. In addition, we make predictions for the three observables in the forthcoming Pb+Pb collisions at 5.36 TeV. We further examine the impacts of final-state interactions and the local scaling of the initial conditions and find that skewness is particularly sensitive to these effects in semi-central and central collisions. In contrast, kurtosis shows little to no sensitivity.

Primary author: 张, 潮 (Central China Normal University)

Presenter: 张, 潮 (Central China Normal University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **136** Type: **Oral**

J/Psi energy correlator measurement at RHIC-STAR

Sunday, 26 October 2025 14:25 (20 minutes)

Quantum Chromodynamics (QCD), the fundamental theory of the strong interaction, governs the behavior of quarks and gluons. Heavy quarks (charm and bottom) hold unique value in strong interaction research: their large masses ensure production is dominantly governed by perturbative QCD, while the formation mechanisms of heavy quarkonium states (e.g., J/ψ) inherently span QCD's perturbative and non-perturbative regimes, providing a unique window into their interplay. This presentation reports the latest heavy quarkonium results from the RHIC-STAR Collaboration, focusing on production characteristics in proton-proton collisions. Through measurements of the J/ψ-energy correlator, we probe the micro-dynamical mechanisms governing quarkonium formation within the non-perturbative QCD regime. Furthermore, we discuss implications for J/ψ spin physics in heavy-ion collisions and their potential role in studying quark-gluon plasma (QGP) properties.

Primary author: YANG, Qian (Shandong University)

Presenter: YANG, Qian (Shandong University)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **139** Type: **Oral**

Status of CEE experiment

Monday, 27 October 2025 10:30 (20 minutes)

Heavy-ion collisions (HICs) serve as a unique experimental tool for investigating the properties of nuclear matter under extreme conditions in the laboratory. At HIRFL-CSR energies, HICs can produce nuclear matter at densities reaching 2–3 times the normal nuclear saturation density. The HIRFL-CSR External-target Experiment (CEE) is a large-acceptance spectrometer specifically designed to explore frontier topics in high-energy nuclear physics, such as the QCD phase structure and the equation of state of nuclear matter. In this talk, we will present an overview of the current status of the CEE experiment, progresses in simulation and data analysis software as well as its future physics program.

Primary author: ZHANG, Yapeng (近代物理研究所)

Presenter: ZHANG, Yapeng (近代物理研究所)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **140** Type: **Oral**

Energy loss of heavy flavor quarks in color string medium of p+p

Sunday, 26 October 2025 16:55 (20 minutes)

The talk presents our preliminary estimates of heavy flavor (HF) quark energy loss during its propagation through the non-equilibrated medium formed in minimum bias proton-proton (p+p) collisions at LHC energies. The study is inspired by the ongoing hot debates on whether tiny droplets of Quark-Gluon Plasma can be created in collisions of small systems. In this work, we assume that the fireball produced in a p+p event can be described by a fluctuating number of quark-gluon strings originated from multi-pomeron exchanges. Considered longitudinal oscillations of strings dynamically initialize medium at each time step. Their varying overlaps create fluctuations in the color field energy density that governs the elastic scattering rate of HF quarks with the gluons populating event string volume. We calculate the transverse momentum dependence of the momentum loss for charm and bottom (anti-)quarks that are produced in initial hard scatterings and traverse the described environment. The simulation is performed using a developed hybrid approach on an event-by-event basis. Our results show significantly lower HF quarks energy loss compared to that obtained in the expanding hydrodynamic scenario of the new EPOS4HQ module.

Primary authors: PROKHOROVA, Daria (Tsinghua University); SHI, Shuzhe (Tsinghua University)

Co-author: Prof. ANDRONOV, Evgeny (St.Petersburg State University)

Presenter: PROKHOROVA, Daria (Tsinghua University)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **144** Type: **Oral**

Three-dimensional coupling between jet and flow in heavy-ion collisions.

Sunday, 26 October 2025 16:15 (20 minutes)

Particles associated with the jet will be deflected from their initial direction due to the scatterings with the thermal partons flowing in the QGP fluid. Such deflections lead to an intra-jet asymmetry coupled with flow, which we can use to extract the properties of the QGP medium. This work calculates the intra-jet asymmetry distribution in both transverse and longitudinal directions and investigates their dependence on path length, local energy gradient, and flow velocity. By studying the intra-jet asymmetry in different rapidity ranges, we extract the average radial flow velocity distribution and compare it with the hydrodynamic simulation results. We also observe jet-flow coupling effects in jet chemistry, especially in the distribution of strangeness inside the jet cone. We further use intra-jet asymmetry and event-shape engineering to localize the initial production position of the jet. The localization accuracy can be improved via the interplay between QGP flow and the diffusion wake induced by the backside jet.

Primary authors: Prof. SALGADO, Carlos (IGFAE); Dr LUO, Tan (Hunan University); WANG, Xin-Nian (Central China Normal University)

Presenter: Dr LUO, Tan (Hunan University)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **145** Type: **Oral**

Production properties of Λ-hypernuclei and Ω-hypernuclei in the coalescence mechanism in relativistic heavy-ion collisions

Monday, 27 October 2025 10:30 (20 minutes)

We study the productions of Λ-hypernuclei ${}^{3}_{\Lambda}\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{He}$ and Ω-hypernuclei $H(p\Omega^{-})$, $H(n\Omega^{-})$, $H(pn\Omega^{-})$ in the coalescence mechanism in relativistic heavy-ion collisions. Considering the abundance and great importance of baryons and light (hyper-)nuclei on the collision dynamics, we include not only nucleon+Λ coalescence but also nucleus+nucleon(Λ) coalescence. We present contributions from different coalescence channels for ${}^{3}_{\Lambda}\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{H}$ and ${}^{4}_{\Lambda}\mathrm{He}$ in their productions. We predict the production asymmetry between ${}^{4}_{\Lambda}\mathrm{H}$ and ${}^{4}_{\Lambda}\mathrm{He}$, characterized by yield ratios ${}^{4}_{\Lambda}\mathrm{He}/{}^{4}_{\Lambda}\mathrm{H}$ and $({}^{4}_{\Lambda}\mathrm{H}-{}^{4}_{\Lambda}\mathrm{He})/({}^{4}_{\Lambda}\mathrm{H}+{}^{4}_{\Lambda}\mathrm{He})$, which can shed light on the existence constraints of the possible neutron-Λ bound states ${}^{2}_{\Lambda}n$ $(n\Lambda)$ and ${}^{3}_{\Lambda}n$ $(nn\Lambda)$.

Primary author: 王, 瑞芹 (曲阜师范大学)

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Presenter: 王, 瑞芹 (曲阜师范大学)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **146** Type: **Oral**

Analytical solution of the nonlinear QCD evolution equations and its applications

In high-energy scattering processes, the partonic density exhibits a crucial phenomenon, primarily dominated by gluonic density at the small-x region. The partonic density increases rapidly with the decrease in Bjorken-x owing to gluon splitting, while the overlapping gluons begin to recombine and become prevalent at high-density. This results in a balance between splitting and recombination, leading to a new state of gluon saturation. The saturation phenomenon is extensively studied through nonlinear evolution equations such as the Balitsky-Kovchegov (BK) equation and the Gribov-Levin-Ryskin-Mueller-Qiu (GLR-MQ) equation.

To provide a more intuitive physical picture and analyze the saturation properties of these nonlinear evolution equations, we employ the homogeneous balance method for the first time to derive analytical solutions for both the BK equation and GLR-MQ equation. Our findings reveal that geometric scaling is an inherent characteristic of our analytical solution, with gluon distribution functions derived from this solution successfully reproducing MSTW2008LO data. Furthermore, predictions regarding J/ψ mesons demonstrate good agreement with experimental data. These results indicate that our analytical solution obtained via the homogeneous balance method effectively describes gluon behavior in the small-x regime.

Primary author: 蔡, 燕兵 (贵州财经大学)

Presenter: 蔡, 燕兵 (贵州财经大学)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **147** Type: **Oral**

Revealing Proton Spin Polarization via Hypertriton Production in Nuclear Collisions

Sunday, 26 October 2025 09:45 (20 minutes)

Ultra-relativistic nuclear collisions create the quark–gluon plasma (QGP) known as the hottest, least viscous, and most vortical fluid ever produced in terrestrial laboratories. Its vortical structure has been uncovered through the spin polarization of Lambda (Λ) hyperons, attributed to the spin–orbit coupling that transfers the system’s orbital angular momentum to the quark spin, which is then inherited by hadrons via quark recombination or coalescence. However, Λ polarization reflects primarily the strange-quark component, leaving the spin dynamics of the up and down quarks largely unexplored. Although the proton is an ideal probe, its stability makes direct measurements experimentally challenging.

In this talk, we propose to unravel proton spin polarization via hypertriton measurements, exploiting the fact that spin information is preserved when polarized nucleons and Λ coalesce to form hypertriton. We show that, over a broad range of collision energies, the polarizations of proton, Λ, and hypertriton are related by a simple linear scaling law. Since both Λ and hypertriton polarizations can be measured via their self-analyzing weak decays, this linear relation provides a practical experimental avenue for accessing spin polarizations of protons and neutrons–the dominant baryonic degrees of freedom in nuclear collisions.

Primary author: 刘, 代能 (复旦大学)

Presenter: 刘, 代能 (复旦大学)

Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **148** Type: **Oral**

Shear and bulk viscosities of gluon plasma across the transition temperature

Sunday, 26 October 2025 09:45 (20 minutes)

Shear and bulk viscosities are two key transport coefficients that characterize the fundamental properties of quark-gluon plasma.They quantify the response of the energy-momentum tensor to shear flow and divergent flow,serving as crucial input parameters for the phenomenological and transport models that interpret experimental data, such as the elliptic flow v_2.
However, calculating these inherently non-perturbative viscosities within lattice QCD presents challenges due to strong ultraviolet fluctuations in the relevant operators. The traditional approach using the multi-level algorithm is highly effective in suppressing UV fluctuations but is limited to the quenched approximation. Recently, the gradient flow method was introduced to address this issue [1], opening the path to full QCD studies. However, Ref. [1] examined only a single temperature, $1.5T_c$.
This work extends the Ref. [1]'s results to a wide temperature range from $0.76T_c$ to $2.25T_c$, focusing on the high-temperature regime while also probing the system's behaviour across the phase transition. The former enables a fair comparison with the next-to-leading-order perturbative estimates which become more reliable at high temperatures, while the latter allows us to study the system's critical dynamics—a topic of wide community concern. The methodology developed in this work provides the foundation for future full QCD calculations.

Reference

[1] L. Altenkort, A.M. Eller, A. Francis, O. Kaczmarek, L. Mazur, G.D. Moore, and H.-T. Shu, Phys. Rev. D 108, 014503 (2023).

Primary authors: ZHANG, Cheng (Central China Normal University); SHU, Hai-Tao (Central China Normal University); DING, Heng-Tong (Central China Normal University)

Presenter: ZHANG, Cheng (Central China Normal University)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)

Contribution ID: **149** Type: **Oral**

A Bayesian inference of chromomagneto fraction in the strong interaction medium

Sunday, 26 October 2025 14:45 (20 minutes)

The chromomagneto monopoles, an excitation of the non-Abelian gauge field that carries chromomagnetic charge, are believed to be important in explaining confinement in vacuum and the strong coupling nature around the confinement-deconfinement transition temperature (T_c). The chromomagneto monopoles have been found to be a solution to the long-standing puzzle that one cannot simultaneously describe the experimental results of the nuclear modification factor ($R_{\rm AA}$) and elliptic flow (v_2) of high-energy particles. Yet, the fraction of chromomagneto monopoles is not precisely known from a theoretical perspective, and we extract its temperature-dependent fraction using Bayesian inference in this work. Our analysis, based on the \textsc{cujet3.1} modeling of the energetic hadrons' $R_{\rm AA}$ and v_2, indicates that the chromomagneto monopole is a significant constituent of the strongly interacting medium near T_c, and its contribution remains non-negligible at high temperatures $T \sim 3\,T_c$. With the extracted chromomagneto fraction, our model yields good agreement with not only the experimental data for energetic hadrons, but also with the state-of-the-art knowledge of the heavy flavor diffusion parameter and the ratio between shear viscosity and entropy.

Primary authors: LIAO, JINFENG (INDIANA UNIVERSITY & RBRC); SHI, Shuzhe (Tsinghua University); 郭, 钰 (Tsinghua University)

Presenter: 郭, 钰 (Tsinghua University)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **154** Type: **Oral**

Measurement of transverse polarization of $\Lambda/\bar{\Lambda}$ inside jets in pp collisions at $\sqrt{s} = 200$ GeV

Monday, 27 October 2025 11:50 (20 minutes)

The fragmentation process has been proposed as a possible origin of the transverse Λ polarization, described by polarizing fragmentation functions (pFFs). In pp collisions, this mechanism can be studied by measuring the Λ polarization within jets. We present the first measurement of the transverse polarization of $\Lambda/\overline{\Lambda}$ hyperons relative to the jet axis in unpolarized pp collisions at $\sqrt{s} = 200$ GeV, using high-statistics data from the STAR experiment. The dependence of the Λ polarization on the jet transverse momentum (p_T^{jet}) is observed. The polarization is also studied as a function of the jet momentum fraction (z) carried by the $\Lambda/\overline{\Lambda}$, and the $\Lambda/\overline{\Lambda}$ momentum transverse to the jet axis (j_T). These results will provide the first constraints on the gluon pFFs. These results also provide an opportunity to test the transverse momentum-dependent (TMD) evolution effect and its universality for pFFs.

Primary author: 高, 涛亚 (Shandong University)

Presenter: 高, 涛亚 (Shandong University)

Session Classification: Parallel III

Track Classification: 核子结构 (nucleon structure)

Contribution ID: **155** Type: **Oral**

Searching for the QCD Critical End Point through (Net-)Proton Fluctuation at RHIC

Sunday, 26 October 2025 11:40 (20 minutes)

Searching for the QCD critical end point is one of the most important topic. In this work, we present the study of net-proton cumulants and factorial cumulants in Au+Au collisions from the RHIC-STAR Beam Energy Scan Phase-II program. Careful event and track selections, with efficiency and systematic corrections, yield high-precision results across energies, centralities, and kinematic windows. The non-monotonic energy dependence of (net-)proton C_4/C_2 in collider mode and fixed-target mode energies, the sign of net-proton hyper order (up to sixth-order) cumulants, a power-law examine of rapidity dependence of proton factorial cumulants, a finite-size scaling for susceptibility, and a Binder cumulant analysis highlight the high μ_B region in the search for the critical point, providing a promising direction for further exploration.

Primary author: HUANG, Yige (Central China Normal University)

Presenter: HUANG, Yige (Central China Normal University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **157** Type: **Oral**

Multijet topology in high-energy nuclear collisions: Jet broadening

Sunday, 26 October 2025 16:35 (20 minutes)

This work presents the first theoretical investigation of the medium modification of jet broadening as an event-shape observable in multijet final states due to jet quenching in high-energy nuclear collisions. The partonic spectrum of pp collisions with next-to-leading order (NLO) accuracy at $\sqrt{s_{\rm NN}} = 5.02$ TeV is provided by the POWHEG+PYTHIA8 event generator, and the linear Boltzmann transport (LBT) model is utilized to investigate the energy loss of fast partons as they traverse through the hot and dense QCD medium. Jet broadening distributions in multijet final states for both pp and Pb+Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV are calculated. We observe an enhancement at the small jet broadening region while a suppression at the large jet broadening region in Pb+Pb collisions relative to that in pp. This suggests that medium modifications with parton energy loss in the QGP lead to a more concentrated energy flow in all observed multijet events in Pb+Pb reactions.

We also demonstrate that the intertwining of two effects, the jet number reduction and the restructured contribution, results in the novel behavior of nuclear modification of the jet broadening observable in Pb+Pb collisions.

Primary authors: 康, 锦文 (华中师范大学); Mr 王, 磊; DAI, Wei (China University of Geosciences); WANG, Sa (China Three Gorges University); ZHANG, Ben-Wei (Central China Normal University)

Presenter: 康, 锦文 (华中师范大学)

Session Classification: Parallel I

Track Classification: 喷注物理 (jet physics)

Contribution ID: **158** Type: **Oral**

Measurement of system size and energy dependence of J/ψ production with the STAR experiment

Sunday, 26 October 2025 17:35 (20 minutes)

In relativistic heavy-ion collisions, the production of J/ψ serves as an important probe for studying the properties of quark-gluon plasma (QGP). However, interpreting the modi-fication of J/ψ yields is challenging due to the interplay of hot, such as dissociation and regeneration, and cold nuclear matter effects. Measuring J/ψ production across various collision systems and energies is therefore essential for gaining deeper insights into QGP properties.
In this talk, we will present the nuclear modification factor (R_{AA}) of J/ψ as a function of centrality and transverse momentum in O+O collisions at $\sqrt{s_{NN}}$ = 200 GeV, as well as in Au+Au collisions at $\sqrt{s_{NN}}$ = 14.6, 17.3, 19.6, and 27 GeV. In particular, the O+O results can be used to explore small-system dynamics and provide a baseline for comparisons with larger systems, such as Au+Au or Pb+Pb collisions, thereby enriching our understanding of nuclear matter behavior across different scales. Furthermore, we examine the energy dependence of J/ψ R_{AA} in central heavy-ion collisions, spanning RHIC to LHC energies, and compare the results with theoretical model predictions.

Primary authors: ZHANG, aoke (South China Normal University); Dr ZHANG, wei (South China Normal University)

Presenters: ZHANG, aoke (South China Normal University); Dr ZHANG, wei (South China Normal University)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **159** Type: **Oral**

Nucleon Tomography with 0-jettiness

Monday, 27 October 2025 11:30 (20 minutes)

We propose a novel strategy to systematically isolate the nucleon’s intrinsic non-perturbative three-dimensional structure by employing 0-jettiness to suppress initial-state radiation in transverse momentum-dependent (TMD) observables. Applying this method to transverse single spin asymmetries (SSAs) in $W^{\pm}$ and Z^0 boson production at RHIC, we demonstrate a substantial enhancement of the asymmetry signal (e.g., by 83% for Z^0 SSA at q = 5 GeV), enabling a more definitive test of the predicted sign change of the Sivers function–a key prediction of TMD factorization. We further explore its applicability to spin-dependent measurements at the Electron-Ion Collider. Our analysis is formulated within a joint resummation framework that systematically resums large logarithms associated with both the veto scale and the gauge boson’s transverse momentum.

Primary authors: FANG, Shen; 林, 硕 (山东大学); SHAO, Dingyu (Fudan University); ZHOU, jian (Shandong University)

Presenter: 林, 硕 (山东大学)

Session Classification: Parallel III

Track Classification: 核子结构 (nucleon structure)

Contribution ID: **160** Type: **Oral**

Quarkonium Spectroscopy in the Quark-Gluon Plasma

Monday, 27 October 2025 09:20 (20 minutes)

The properties of bound states are fundamental to hadronic spectroscopy and play a central role in the transition from hadronic matter to a quark-gluon plasma (QGP). In a strongly coupled QGP (sQGP), the interplay of temperature, binding energy and large collisional widths of the partons poses formidable challenges in evaluating the in-medium properties of hadronic states and their eventual melting. In particular, the existence of heavy quarkonia in the QGP is a long-standing problem that is hard to solve by considering their spectral properties on the real-energy axis. We address this problem by analyzing in-medium thermodynamic quarkonium T-matrices in the complex energy plane. We first validate this method in vacuum, where the T-matrix poles of observed states are readily identified. When deploying this approach to recent self-consistently calculated T-matrices in the QGP, we find that poles in the complex energy plane can persist to surprisingly large temperatures, depending on the strength of the in-medium interactions. While the masses and widths of the pole positions are precisely defined, the notion of a binding energy is not due to the absence of thresholds caused by the (large) widths of the underlying anti-/quark spectral functions. Our method thus provides a new and definitive quantum-mechanical criterion to determine the melting temperature of hadronic states in the sQGP while increasing the accuracy in the theoretical determination of transport parameters.

Primary author: Dr TANG, Zhanduo

Co-authors: Prof. HANLON, Andrew (Kent State University); Prof. MUKHERJEE, Swagato (Brookhaven National Laboratory); Dr WU, Biaogang (Texas A&M University); Prof. PETRECZKY, Peter (Brookhaven National Laboratory); Prof. RAPP, Ralf (Texas A&M University)

Presenter: Dr TANG, Zhanduo

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **163** Type: **Oral**

Quantum Entanglement of Particles With Zero Lifetime in Photoproduction Process

Sunday, 26 October 2025 15:25 (20 minutes)

The Drell-Soding mechanism, which describes non-resonant pair production via linearly polarized virtual photons in ultra-peripheral heavy-ion collisions, arises from the coherent superposition of contributions from both colliding nuclei. The angular momentum of the system is imprinted in the orbital angular momentum of the produced pair, leading to quantum entanglement between the two particles. Since the produced particles cease to interact with each other after production, they can be treated as an Einstein-Podolsky-Rosen pair while simultaneously being considered as decaying particles with zero lifetime. In this work, we calculate the momentum modulation of Drell-Soding pairs induce by spin interference effects. These findings not only establish measurable signatures of entanglement in relativistic collisions but also offer new opportunities to test fundamental aspects of quantum electrodynamics and information transfer in high-energy environments, bridging the gap between quantum information science and particle physics phenomenology.

Primary authors: 查, 王妹 (中国科学技术大学近代物理系); 吴, 鑫 (中国科学技术大学)

Presenter: 吴, 鑫 (中国科学技术大学)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **164** Type: **Oral**

Measurement of Hypertriton Production at RHIC

Monday, 27 October 2025 11:10 (20 minutes)

Hypernuclei are bound nuclear systems of nucleons and hyperons. The hypernuclei production mechanism in heavy-ion collisions remains not fully understood. In particular, the hypertriton ($^3_\Lambda$H), a bound state consisting of a proton, neutron, and hyperon, is the lightest known hypernucleus with a remarkably small binding energy. Precise measurements of the energy and multiplicity dependencies of the production of $^3_\Lambda$H will provide crucial information on the mechanisms of hypernuclei production.

In this presentation, we report comprehensive measurements from the STAR experiment at RHIC on the collision energy dependence of $^3_\Lambda$H mean transverse momentum ($\langle p_T \rangle$), p_T-integrated yield, and the yield double ratio $S_3 = {}^3_\Lambda\mathrm{H}/\left({}^3\mathrm{He} \times (\Lambda/p)\right)$ in mid-rapidity in Au + Au collisions at collision energies between 3 and 27 GeV, covering the region of high baryon density. Within this energy range, we also investigate the system size dependence of S_3 through charged-particle multiplicity. In addition to the measurements in Au+Au collisions, at the top RHIC energy ($\sqrt{s_{NN}} = 200$ GeV) we also present recent results on S_3 from isobar (Zr+Zr and Ru+Ru) collisions. These results will be compared with model calculations, and physics implications on hypernuclei production mechanism will be discussed.

Primary author: LI, Xiujun (USTC)

Presenter: LI, Xiujun (USTC)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **170** Type: **Oral**

Neural network extraction of chromo-electric and chromo-magnetic gluon masses

Monday, 27 October 2025 09:40 (20 minutes)

We present a neural network-based quasi-particle model to separate the contributions of chromo-electric and chromo-magnetic gluons. Using dual residual networks, we extract temperature-dependent masses from SU(3) lattice thermodynamic data of pressure and trace anomaly. After incorporating physics regularizations, the trained models reproduce lattice results with high accuracy over $T/T_c \in [1, 10]$, capturing both the crossover behavior near T_c and linear scaling at high temperatures. The extracted masses exhibit a physically reasonable behavior: they decrease sharply around T_c and increase linearly thereafter. We find significant differences between thermal and screening masses near T_c, reflecting non-perturbative dynamics, while they converge at T
$gtrsim 2T_c$.

Primary authors: MEI, Jie (中国科学院大学物理科学学院); Prof. WANG, Lingxiao (Riken); Prof. HUANG, Mei (中国科学院大学核科学与技术学院)

Presenter: MEI, Jie (中国科学院大学物理科学学院)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **172** Type: **Oral**

Probing Nuclear Cluster Structure and Nucleon-Nucleon Correlations in Heavy-Ion Collisions

Sunday, 26 October 2025 15:05 (20 minutes)

This work presents a comprehensive theoretical investigation into the influence of nuclear microstructure, specifically nucleon-nucleon (NN) correlations and α-cluster structures, on initial-state fluctuations in heavy-ion collisions. By establishing a direct link between nuclear structure details and experimentally measurable observables, we provide crucial theoretical predictions for upcoming experiments at the Large Hadron Collider (LHC).
we propose a novel approach to distinguish between competing α-cluster configurations in light nuclei, using the 20Ne nucleus as a case study. We use the microscopic Brink cluster model to describe two key configurations: a bowling-pin-like α+16O structure and a bi-pyramidal 5α structure. By analyzing initial-state quantities, we identify the normalized symmetric cumulant NSC(3,2) and the Pearson coefficient ρ(ϵ32,δd⊥) as quantitative discriminators. We demonstrate that these observables exhibit a characteristic sign inversion between the two configurations. Specifically, the α+16O configuration predicts a positive NSC(3,2) and negative ρ(ϵ32,δd⊥), while the 5α configuration reverses these signs. This sign discrimination provides a robust and unambiguous method to identify α-clustering and differentiate complex nuclear structures. These analytical predictions can be directly tested in upcoming ultra-central Ne+Ne collisions at the LHC, as well as in fixed-target Pb+Ne collisions, offering complementary probes of the cluster configurations. Our work establishes a new paradigm for probing many-body quantum correlations and nuclear structure transitions through high-energy heavy-ion collisions.
Second, our research addresses two distinct but related facets of nuclear structure. First, we explore the effect of short-range NN correlations on high-energy collisions. We developed a novel Monte Carlo sampling method based on the Adaptive Grid Monte Carlo (AGMC) algorithm to efficiently generate nucleon spatial distributions that include many-body correlation effects. Our analysis reveals that higher-order initial-state fluctuation observables, particularly the third-order cumulant cE/S{3}, exhibit significant sensitivity to these correlations, with a relative deviation exceeding 10% between correlated and uncorrelated systems. This suggests that the final-state three-particle transverse momentum correlation ⟨(δpT)3⟩ is a highly sensitive observable for probing NN correlations. We find that the effect of NN correlations is more pronounced in large spherical nuclei than in smaller systems, as the effects of particle position fluctuations are suppressed in larger nuclei. We also demonstrate that the NN correlation effect on the second-order eccentricity ϵ2 is significantly greater than on the third-order eccentricity ϵ3, which provides a potential solution to the v2−v3 puzzle observed in ultra-central Pb-Pb collisions. These findings not only constrain theoretical models of NN interactions but also highlight the importance of considering NN correlations when extracting properties of the quark-gluon plasma (QGP), such as the speed of sound.
In summary, this research underscores the power of heavy-ion collisions as a tool for nuclear structure research. By combining a novel Monte Carlo sampling method to incorporate NN correlations with a rigorous analytical framework for discriminating cluster structures, our work provides critical, quantitative predictions for future experimental programs, advancing our understanding of the fundamental properties of nuclear matter.

Primary author: 李, 沛 (Fudan University)

Co-authors: Mr 马, 国亮 (复旦大学); Mr 周, 波 (复旦大学); Mr 孙, 开佳 (复旦大学)

Presenter: 李, 沛 (Fudan University)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **173** Type: **Oral**

Measurement of the production of hypertriton with ALICE

Monday, 27 October 2025 11:50 (20 minutes)

The production of hypertriton has been proposed as an effective method to study the nucleosynthesis mechanism in high-energy hadronic collisions. Within the coalescence picture, the yield of nulcei are sensitive to the interplay between the source size and the spatial distribution of their internal wave function, whereas in the statistical hadronization framework nuclear structure plays little role in the production yield. The hypertriton is found to be a loosely bound state with a size around 10 fm due to the small Λ separation energy about one hundred keV, making it an ideal probe for distinguishing between different nucleosynthesis models. Furthermore, measurements of the branching ratios for its various decay channels can provide insights into the ΛN interaction.

In this contribution, the recent ALICE measurements of hypertriton production in various collision systems and through different decay channels will be presented. In addition, the application of a new method called "strangeness tracking" developed with the upgraded ALICE Inner Tracking System (ITS2) on the measurement of hypertriton will also be shown.

Primary author: Mr WANG, Yuanzhe (Fudan University)

Presenter: Mr WANG, Yuanzhe (Fudan University)

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **174** Type: **Oral**

Phase transition and correlations in a system with T-gradients

Sunday, 26 October 2025 09:05 (20 minutes)

The QGP fireball is a temporally fast-evolving and spatially highly nonuniform system. Instantaneously, the spatial temperature gradients are huge and will have significant influence on the spatial distribution of QCD order parameter and its correlations, but related studies are inadequate. Based on the local equilibrium assumption and the Markov assumption, we will discuss the phase transition in an instantly steady 2D disk system with temperature gradients. We will present the spatially-nonuniform-temperature effects on the phase transition temperature, the eigen-modes of the fluctuations, and the nonlocal and local correlations via a simplified Ising-like model [1].

[1] Lijia Jiang, Tao Yang and Jun-Hui Zheng, in preparation.

Primary author: JIANG, Lijia (Northwest University)

Presenter: JIANG, Lijia (Northwest University)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **175** Type: **Oral**

Hydrodynamization Time Hierarchies Across n-Point Functions

Sunday, 26 October 2025 16:15 (20 minutes)

Significant progress, particularly in holography, has clarified how rapidly two-point functions hydrodynamize after a quench. Motivated by non-Gaussian observables relevant to the QCD critical-point program, we ask: how do higher-point functions hydrodynamize relative to two-point functions? We propose two conjectures that organize the ordering and scaling of hydrodynamization times across correlator order in large-N, strongly coupled quantum field theories with a conserved charge. Within a Schwinger–Keldysh effective theory for diffusion and its nonlinear couplings, we demonstrate that these conjectures hold for a broad class of microscopic models. We also comment on their fate in an expanding large-N QCD plasma, both far from and near the critical point.

Primary author: Prof. ABBASI, Navid (Lanzhou University)

Presenter: Prof. ABBASI, Navid (Lanzhou University)

Session Classification: Parallel III

Track Classification: 新的理论方法 (new theoretical methods)

Contribution ID: **177** Type: **Oral**

QCD phase transition and the confining dynamics at finite density via functional approach

Sunday, 26 October 2025 09:45 (20 minutes)

With the new heavy-ion collision facilities at FAIR (CBM) and HIAF (CEE+) being nearly completed, the experimental researches in the high baryon density region of QCD phase diagram are entering the precision physics era. There is in turn a great demand on the first-principles QCD computations in theory, in order to have a clear understanding on the observational signatures in experiments.
To date, a *direct* QCD computation at high density can only be achieved by the continuum, functional approach, as the first-principles lattice QCD approach is suffering from the sign problem. I would then like to highlight some recent progresses of the functional approach in the study of QCD thermodynamic observables at high density.
In concrete, the talk will cover our recent work on the confinement-deconfinement phase transition and its finite-density signatures in the QCD equation of state (arXiv:2504.05099). Besides, the spinodal decomposition in the chiral dynamics and confining dynamics is discovered recently beyond the QCD critical end point (arXiv:2509.02974), whose indications on the inhomogeneous structure of dense nuclear matter will also be discussed.

Primary authors: 陆, 易 (北京大学); 刘, 玉鑫 (PKU); 高, 飞 (Beijing Institute of technology)

Presenter: 陆, 易 (北京大学)

Session Classification: Parallel I

Track Classification: QCD 相变与状态方程 (QCD phase transition and equation of state)

Contribution ID: **179** Type: **Oral**

Charm baryon decay constants in Lattice QCD

Sunday, 26 October 2025 17:15 (20 minutes)

We present the first calculation of charmed baryon decay constants using 2+1 flavor gauge ensembles with lattice spacings ranging from 0.05 to 0.1 fm and pion masses between 136 and 310 MeV. Under SU(3) flavor symmetry, we construct the charmed baryon interpolating operators and compute the corresponding hadronic matrix elements to extract the bare decay constants for each ensemble. The non-perturbative renormalization is performed using the symmetric momentum-subtraction scheme. After performing systematic chiral and continuum extrapolations, we obtain the decay constants with 8-18\% precision.

Primary author: Mr 王, 光宇

Presenter: Mr 王, 光宇

Session Classification: Parallel II

Track Classification: 重味与奇异粒子 (heavy flavor and strangeness)

Contribution ID: **180** Type: **Oral**

Effects of quark gluon plasma droplet evolution on charge separation in small collision systems

Sunday, 26 October 2025 12:00 (20 minutes)

In relativistic high-energy heavy-ion collisions, the chiral magnetic effect (CME) could produce a charge separation in quark gluon plasma (QGP) and remain in the final hadron system during evolution, observed as the correlator . However, in collisions, the background effect makes a significant contribution. Therefore, we propose to study the contribution of CME to through collisions. We investigated the property of electromagnetic fields generated in polarized proton collisions. We found that the orientation of fields exhibit a significant dependence on the polarization direction of the protons. And the azimuthal correlation between and reaction plane is obviously.
We also studied the initial charge separation surviving to the final hadron system in high energy small collision system. Our calculations indicate that, with given initial charge separation, the effects of parton level evolution and hadron level evolution weaken the charge separation indeed, but there are still enough signals that could survive to the final hadron system. Furthermore, we found that, the contribution of background to γ is negligible in small collision systems.

Primary author: Mr 许, 易

Presenter: Mr 许, 易

Session Classification: Parallel II

Track Classification: 自旋极化和手征效应 (spin polarization and chiral effect)

Contribution ID: **185** Type: **Oral**

Updates on Experimental search for CME

Saturday, 25 October 2025 10:45 (30 minutes)

Presenter: CHEN, Jinhui (Fudan University)

Session Classification: Plenary

Contribution ID: **186** Type: **Oral**

Recent results on QCD critical point from STAR

Saturday, 25 October 2025 11:45 (30 minutes)

Presenter: ZHANG, Yu (Guangxi Normal University)

Session Classification: Plenary

Contribution ID: **187** Type: **Oral**

Recent ALICE Highlights

Saturday, 25 October 2025 08:30 (30 minutes)

Presenter: ZHANG, Xiaoming (Central China Normal University)

Session Classification: Plenary

Contribution ID: **188** Type: **Oral**

CMS Overview

Saturday, 25 October 2025 09:00 (30 minutes)

Presenter: YANG, Shuai (South China Normal University)

Session Classification: Plenary

Contribution ID: **189** Type: **Oral**

Hyperon-Nucleon Spectrometer at HIAF

Tuesday, 28 October 2025 10:45 (30 minutes)

Presenter: GUO, Aiqiang (Institute of modern physics, Chinese Academy of Sciences)

Session Classification: Plenary

Contribution ID: **190** Type: **Oral**

Highlights of RHIC Spin Program

Saturday, 25 October 2025 11:15 (30 minutes)

Presenter: ZHANG, Jinlong (Shandong University)

Session Classification: Plenary

Contribution ID: **191** Type: **Oral**

Recent results from LHCb

Saturday, 25 October 2025 09:30 (30 minutes)

Presenter: ZHU, Xianglei (Tsinghua University)

Session Classification: Plenary

Contribution ID: **192** Type: **Oral**

From HIAF to EicC

Tuesday, 28 October 2025 10:15 (30 minutes)

Presenter: 赵, 宇翔 (中国科学院近代物理研究所)

Session Classification: Plenary

Contribution ID: **193** Type: **Oral**

QCD phase diagram at high baryon densities

Tuesday, 28 October 2025 08:15 (30 minutes)

Presenter: 付, 伟杰 (大连理工大学)

Session Classification: Plenary

Contribution ID: **194** Type: **Oral**

Spin polarization and alignment in heavy ion collisions

Saturday, 25 October 2025 14:00 (30 minutes)

Presenter: LIN, Shu (Sun Yat-Sen University)

Session Classification: Plenary

Contribution ID: **196** Type: **Oral**

Hydrodynamization of QGP from classical and quantum perspectives

Saturday, 25 October 2025 14:30 (30 minutes)

Presenter: SHI, Shuzhe (Tsinghua University)

Session Classification: Plenary

Contribution ID: **197** Type: **Oral**

JET modification in QGP

Saturday, 25 October 2025 16:30 (30 minutes)

Presenter: 柯 (KE), 伟尧 (Weiyao) (华中师范大学)

Session Classification: Plenary

Contribution ID: **198** Type: **Oral**

AI for HIC

Saturday, 25 October 2025 16:00 (30 minutes)

Presenter: 庞, 龙刚 (C)

Session Classification: Plenary

Contribution ID: **199** Type: **Oral**

Spin hydrodynamics

Saturday, 25 October 2025 15:00 (30 minutes)

Presenter: PU, Shi (University of Science and Technology of China)

Session Classification: Plenary

Contribution ID: **200** Type: **Oral**

Hyper-nucleus production in HIC

Tuesday, 28 October 2025 08:45 (30 minutes)

Presenter: SUN, KaiJia (Institute of Modern Physics, Fudan University)

Session Classification: Plenary

Contribution ID: **201** Type: **Oral**

Recent results from Lattice QCD

Saturday, 25 October 2025 13:30 (30 minutes)

Presenter: DING, Heng-Tong (Central China Normal University)

Session Classification: Plenary

Contribution ID: **202** Type: **Oral**

Connections between heavy-ion Collisions and EIC/UPC

Saturday, 25 October 2025 17:00 (30 minutes)

Presenter: 赵, 文彬 (华中师范大学)

Session Classification: Plenary

Contribution ID: **203** Type: **Oral**

Recent results from ATLAS

Sunday, 26 October 2025 08:20 (25 minutes)

Presenter: HU, Qipeng (University of Science and Technology of China)

Session Classification: Parallel III, Invited Talk

Contribution ID: **204** Type: **Oral**

Neutron skin and symmetry energy

Sunday, 26 October 2025 10:35 (25 minutes)

Presenter: XU, Haojie (Huzhou University)

Session Classification: Parallel III, Invited Talk

Contribution ID: **205** Type: **Oral**

Baryon Polarimeter

Sunday, 26 October 2025 10:35 (25 minutes)

Presenter: LIANG, Yutie (Institute of Modern Physics, CAS)

Session Classification: Parallel II, Invited Talk

Contribution ID: **206** Type: **not specified**

Jet experimental review

Sunday, 26 October 2025 14:00 (25 minutes)

Presenter: HOU, Yongzhen (GSI & CUG)

Session Classification: Parallel I, Invited Talk

Contribution ID: **207** Type: **Oral**

Recent heavy flavour production measurements from ALICE experiment

Sunday, 26 October 2025 14:00 (25 minutes)

Presenter: ZHANG, Yifei (University of Science and Technology of China)

Session Classification: Parallel II, Invited Talk

Contribution ID: **208** Type: **Oral**

Relation between QCD phase transition and polarization

Sunday, 26 October 2025 10:35 (25 minutes)

Presenter: 陈, 浩磊 (复旦大学)

Session Classification: Parallel I, Invited Talk

Contribution ID: **209** Type: **Oral**

QCD matter under external electromagnetic fields

Sunday, 26 October 2025 08:20 (25 minutes)

Presenter: 毛, 施君 (西安交通大学)

Session Classification: Parallel I, Invited Talk

Contribution ID: **210** Type: **Oral**

Quantum simulation of high-energy physics and beyond

Tuesday, 28 October 2025 09:15 (30 minutes)

Presenter: 郭, 星雨 (scnu)

Session Classification: Plenary

Contribution ID: **211** Type: **Oral**

Spin polarization as a novel probe of jet quenching

Sunday, 26 October 2025 08:20 (25 minutes)

Presenter: WEI, Shu-yi (Shandong University)

Session Classification: Parallel II, Invited Talk

Contribution ID: **212** Type: **Oral**

Onset of Constituent Quark Number Scaling in Heavy-Ion Collisions at RHIC

Monday, 27 October 2025 08:20 (20 minutes)

One of the central goals of the RHIC Beam Energy Scan is to identify the transition from ordinary hadronic matter to the Quark–Gluon Plasma (QGP). Elliptic flow (v_2), which reflects the azimuthal anisotropy of particle emission, serves as a sensitive probe of collectivity and the active degrees of freedom of the medium. Over the past two decades, systematic studies of collectivity across quark flavors, from light to multi-strange hadrons and even charm hadrons, in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV have built a detailed history of partonic collectivity at RHIC. Systematic studies of v_2 across light, strange, and multi-strange hadrons have demonstrated partonic collectivity at top RHIC energies down to $\sqrt{s_{NN}}$ = 7.7 GeV, while results at $\sqrt{s_{NN}}$ = 3.0 GeV show that the system is dominated by hadronic interactions.

Recent STAR measurements reveal that at $\sqrt{s_{NN}}$ ≤3.2GeV, the Number-of-Constituent-Quark (NCQ) scaling is strongly violated, consistent with a hadronic equation of state. As the collision energy increases, a gradual emergence of NCQ scaling is observed, suggesting that parton-level collectivity develops in Au+Au collisions at 4.5 GeV. The breakdown followed by the onset of NCQ scaling provides direct evidence for the transition from hadronic to partonic dominance. These findings establish collectivity as a powerful tool to map the QCD phase structure, advance our understanding of the QGP as a new form of strongly interacting matter, and shed light on the conditions of
the early universe.

Primary author: 施, 梳苏 (Central China Normal University)

Presenter: 施, 梳苏 (Central China Normal University)

Session Classification: Parallel III

Track Classification: 集体流和关联 (collective flow and correlation)