The 9th Asian Triangle Heavy-Ion Conference (ATHIC 2023)

Report of Contributions

https://indico.cern.ch/e/athic2023

Contribution ID: **65** Type: **Poster**

Production of ΩNN and ΩΩN in ultra-relativistic heavy-ion collisions

Tuesday 25 April 2023 16:20 (20 minutes)

The studies of multi-strangeness hypernuclei help us further understand the interaction between hyperons and nucleons. This work discusses the productions of triple-baryons including Ω, namely ΩNN and $\Omega\Omega N$, their decay channels and the baryon number dependence of productions. A variation method is used in calculations of bound states and binding energy of ΩNN and $\Omega\Omega N$ with the potentials from the HAL-QCD's results. The productions of ΩNN and $\Omega\Omega N$ are predicted by using a blast-wave model plus coalescence model in ultra-relativistic heavy-ion collisions at $\sqrt{s_{NN}} = 200$ GeV and 2.76 TeV. The decay channel are simply discussed based on the coupled channels appeared in HAL-QCD calculation. Furthermore, plots for baryon number dependent yields of different baryons (N and Ω), their dibaryons and hypernuclei are made and the production rate of a more exotic tetra-baryon ($\Omega\Omega NN$) is extrapolated.

Theory / experiment

Theory

Group or collaboration name

Primary authors: ZHANG, Liang (Shanghai Institute of Applied Physics, Chinese Academy of Sciences); ZHANG, Song (Fudan University (CN)); MA, Yugang (Fudan University (CN))

Presenter: ZHANG, Liang (Shanghai Institute of Applied Physics, Chinese Academy of Sciences)

Session Classification: Poster Session

Track Classification: Hadron interactions and exotics

Contribution ID: **66** Type: **Oral**

A Large N expansion for Minimum Bias

Wednesday 26 April 2023 15:50 (25 minutes)

Despite being the overwhelming majority of events produced in hadron or heavy ion collisions, minimum bias events do not enjoy a robust first-principles theoretical description as their dynamics are dominated by low-energy quantum chromodynamics. I will present a novel expansion scheme of the cross section for minimum bias events that exploits an ergodic hypothesis for particles in the events, and events in an ensemble of data. The expansion parameter that is identified is the number of detected particles, N. This approach enables unified treatment of small and large system collective behaviour, for instance being equally applicable to collective behaviour in heavy ion collisions and pp collisions.

Theory / experiment

Theory

Group or collaboration name

Primary author: MELIA, Tom (Kavli IPMU)

Presenter: MELIA, Tom (Kavli IPMU)

Session Classification: Parallel Session B

Track Classification: New theoretical developments

Contribution ID: **73** Type: **Oral**

Heavy quarks probe the equation of state of QCD matter in heavy-ion collisions

Wednesday 26 April 2023 17:05 (25 minutes)

We show for the first time that heavy flavor quenching and flow can be utilized to probe the equation of state (EoS) of quark-gluon plasma (QGP) produced in relativistic heavy-ion collisions. Based on our quasi-particle linear Boltzmann transport (QLBT) model that is coupled to a (3+1)-dimensional viscous hydrodynamic simulation of the QGP and a hybrid fragmentation-coalescence approach for heavy flavor hadronization, we perform a detailed analysis on the D meson $R_{\rm AA}$ and v_2 data at RHIC and the LHC using the state-of-the-art Bayesian statistical framework. A simultaneous constraint on the QGP EoS and the heavy quark transport coefficient is achieved, both consistent with the lattice QCD results.

[1] Feng-Lei Liu, Wen-Jing Xing, Xiang-Yu Wu, Guang-You Qin, Shanshan Cao, Xin-Nian Wang, Eur.Phys.J.C 82 (2022) 4, 350.
[2] Feng-Lei Liu, Xiang-Yu Wu, Shanshan Cao, Guang-You Qin, Xin-Nian Wang, to be submitted

Theory / experiment

Theory

Group or collaboration name

Primary authors: LIU, Feng-lei; WU, Xiang-Yu; CAO, Shanshan (Shandong University); QIN, Guang-You (Central China Normal University); Dr WANG, Xin-Nian (Lawrence Berkeley National Lab. (US))

Presenter: LIU, Feng-lei

Session Classification: Parallel Session A

Track Classification: Heavy quarks and quarkonia

Contribution ID: **76** Type: **Oral**

Latest results on high multiplicity pp and p-Pb collisions with CMS

Wednesday 26 April 2023 13:50 (25 minutes)

At sufficiently high temperatures and pressure, Quantum Chromodynamics predicts that ordinary nuclear matter undergoes a phase transition. This new state of matter is called Quark Gluon Plasma (QGP) and is characterized by deconfined quarks and gluons. In this context, high energy heavy ion collions have been historically used to recreate the QGP in the laboratory. In recent years, at the Large Hadron Collider, similar heavy ion -like features have been observed in events with high final-state multiplicity in proton-proton (pp) and proton-lead (p-Pb) collisions. Raising the question if a QGP is created in these small systems. While models based on a hydrodynamic approach can correctly describe these observed features, other approaches based on microscopic effects (string percolation, color reconnection, etc) can also reproduce the experimental data. In this talk I will present and discuss the latest results on high multiplicity pp and p-Pb collisions with the CMS experiment.

Theory / experiment

Experiment

Group or collaboration name

CMS

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

Presenter: VALENCIA PALOMO, Lizardo (Universidad de Sonora (MX))

Session Classification: Parallel Session B

Track Classification: QGP in small systems

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

3D Structure of Jet-Induced Diffusion Wake in an Expanding Quark-Gluon Plasma

Monday 24 April 2023 15:50 (25 minutes)

Diffusion wake accompanying the jet-induced Mach-cone provides a unique probe of the properties of quark-gluon plasma in high-energy heavy-ion collisions. We explore the 3D structure of the diffusion wake induced by γ-triggered jets in Pb+Pb collisions at the LHC energy within CoLBT-hydro model. We identify a valley structure caused by the diffusion wake on top of a ridge from the initial multiple parton interaction (MPI) in jet-hadron correlation as a function of rapidity and azimuthal angle. This leads to a double-peak structure in the rapidity distribution of soft hadrons in the opposite direction of the jets as an unambiguous signal of the diffusion wake. Using a two-Gaussian fit, we extract the diffusion wake and MPI contributions to the double peak. The diffusion wake valley is found to deepen with the jet energy loss as characterized by the γ-jet asymmetry. Its sensitivity to the equation of state and shear viscosity is also studied.

Theory / experiment

Theory

Group or collaboration name

Primary authors: YANG, Zhong (CCNU); Dr WANG, Xin-Nian (Lawrence Berkeley National Lab. (US))

Presenter: YANG, Zhong (CCNU)

Session Classification: Parallel Session C

Track Classification: Jets and medium response

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

The gradient tomography of dijet production in heavy-ion collisions

Monday 24 April 2023 16:15 (25 minutes)

Abstract: Jet energy loss and transverse momentum broadening can be implicitly represented by jet transport coefficient $\hat{q}$ distributed in the whole phase space of the QGP medium. The gradient of $\hat{q}$ perpendicular to the momentum direction of an energetic parton leads to an asymmetry of the transverse momentum distribution, which can be used for the initial jet production localization. We study such an asymmetry caused by the subleading jet by triggering the leading jet propagating in-plane. Simulations are performed in the linear Boltzmann transport model with event-by-event 3+1D viscous hydrodynamic backgrounds. We find that the initial jet production vertex can be localized by combining the dijet transverse imbalance $x_J = p_T^{\rm subleading}/p_T^{\rm leading}$ and subleading jet transverse gradient asymmetry for different leading jet p_T regions. The correlation between both quantities is also investigated to illustrate the properties of $\hat{q}$.

Theory / experiment

Theory

Group or collaboration name

Primary authors: Dr HE, Yayun (South China Normal University); Dr WANG, Xin-Nian (Lawrence Berkeley National Lab. (US))

Presenter: Dr HE, Yayun (South China Normal University)

Session Classification: Parallel Session C

Track Classification: Jets and medium response

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

Transverse momentum broadening in expanding medium induced cascades

Wednesday 26 April 2023 13:50 (25 minutes)

In this work, we explore the impact of expansion of medium on angular distribution of gluons at different kinematical scales in a medium-induced cascade. Firstly, we study the scaling of the gluon spectra at low–x between expanding and static media and numerically obtain transverse momentum broadened spectra. Next, we study angular distributions for the in-cone radiation for different media and observe out-of-cone energy loss proceeds via radiative break-up of hard fragments followed by angular broadening of softer ones. We note angular distributions for soft fragments are similar for different media. Also, harder jet fragments within jets inside a cone are more sensitive to details of medium expansion as compared to softer fragments which are responsible for most of the gluon multiplicity in cascade. Finally, we observe that cascades in expanding media are relatively more collimated compared to static media and discuss phenomenological implications on jet quenching observables.

Theory / experiment

Theory

Group or collaboration name

Primary author: Mr ADHYA, Souvik Priyam (Institute of Nuclear Physics, Polish Academy of Sciences)

Co-authors: KUTAK, Krzysztof (Instytut Fizyki Jadrowej Polskiej Akademii Nauk); PLACZEK, Wiesiek (Jagiellonian University (PL)); ROHRMOSER, Martin (IFJ-PAN Krakow); TYWONIUK, Konrad (University of Bergen (NO))

Presenter: Mr ADHYA, Souvik Priyam (Institute of Nuclear Physics, Polish Academy of Sciences)

Session Classification: Parallel Session A

Track Classification: Jets and medium response

Contribution ID: **81** Type: **Oral**

Local and global polarization of Λ hyperons across RHIC-BES energies: The roles of spin hall effect, initial condition, and baryon diffusion

Monday 24 April 2023 15:05 (25 minutes)

We perform a systematic study on the local and global spin polarization of Λ and $\bar{\Lambda}$ hyperons[1] in relativistic heavy-ion collisions at beam energy scan energies via the (3+1)-dimensional CLVisc hydrodynamics model[2] with a AMPT and SMASH initial conditions. Following the quantum kinetic theory, we decompose the polarization vector as the parts induced by thermal vorticity, shear tensor and the spin Hall effect (SHE). We find that the polarization induced by the SHE and the total polarization strongly depends on the initial conditions. And the polarization along the beam direction is sensitive to the baryon diffusion coefficient, but the local polarization along the out-of-plane direction is not. Our results for the global polarization agree well with the data of the STAR Collaboration.

[1] Xiang-Yu Wu, Cong Yi, Guang-You Qin, and Shi Pu, Phys.Rev.C 105, 064909 (2022)
[2]Xiang-Yu Wu, Guang-You Qin, Long-Gang Pang, and Xin-Nian Wang, Phys. Rev.C 105,034909(2022)

Theory / experiment

Theory

Group or collaboration name

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

Presenter: WU, Xiang-Yu

Session Classification: Parallel Session B

Track Classification: Intense field and vorticity

Contribution ID: **82** Type: **Oral**

Looking for Mach cones in QGP using deep learning

Monday 24 April 2023 16:40 (25 minutes)

Mach cones are expected to form in the expanding quark-gluon plasma (QGP) when energetic quarks and gluons (called jets) traverse the hot medium at a velocity faster than the speed of sound in high-energy heavy-ion collisions. The shape of the Mach cone and the associated diffusion wake are sensitive to the initial jet production location and the jet propagation direction relative to the radial flow because of the distortion by the collective expansion of the QGP and large density gradient. We develop a deep learning assisted jet tomography which uses the full information of the final hadrons from jets to localize the initial jet production positions. This method can help to constrain the initial regions of jet production in heavy-ion collisions and enable a differential study of Mach-cones with different jet path length and orientation relative to the radial flow of the QGP in heavy-ion collisions.

Theory / experiment

Theory

Group or collaboration name

Primary authors: PANG, LongGang (Central China Normal University); CHEN, WEI (CCNU); Dr KE, Weiyao (Los Alamos National Laboratory); Dr WANG, Xin-Nian (Lawrence Berkeley National Lab. (US)); Dr HE, Yayun (South China Normal University); YANG, Zhong (CCNU)

Presenter: PANG, LongGang (Central China Normal University)

Session Classification: Parallel Session C

Track Classification: Jets and medium response

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

Relativistic spin dynamics for vector mesons

Monday 24 April 2023 15:50 (25 minutes)

We propose a relativistic theory for spin density matrices of vector mesons based on Kadanoff-Baym equations in the closed-time-path formalism. The theory puts the calculation of spin observables such as the spin density matrix element ρ_{00} for vector mesons on a solid ground. Within the theory we formulate ρ_{00} for ϕ mesons into a factorization form in separation of momentum and space-time variables. The key observation is that there is correlation inside the ϕ meson wave function between the ϕ field that polarizes the strange quark and that polarizes the strange antiquark. This is reflected by the fact that the contributions to ρ_{00} are all in squares of fields which are nonvanishing even if the fields may strongly fluctuate in space-time. The fluctuation of strong force fields can be extracted from ρ_{00} of quarkonium vector mesons as links to fundamental properties of quantum chromodynamics.

Theory / experiment

Theory

Group or collaboration name

Primary authors: OLIVA, Lucia (Università di Catania, INFN Catania); Prof. WANG, Qun (University of Science and Technology of China); Dr SHENG, Xin-Li; Dr WANG, Xin-Nian (Lawrence Berkeley National Lab. (US)); LIANG, Zuo-tang (Shandong Uniersity)

Presenter: Prof. WANG, Qun (University of Science and Technology of China)

Session Classification: Parallel Session B

Track Classification: Intense field and vorticity

Contribution ID: **85** Type: **Oral**

Initial state and thermal equilibrium (Theory)

Monday 24 April 2023 10:00 (40 minutes)

Presenter: TAYA, Hidetoshi

Session Classification: Plenary Session

Contribution ID: **86** Type: **not specified**

Welcome Address

Monday 24 April 2023 09:30 (10 minutes)

Presenter: SHIGAKI, Kenta (Hiroshima University (JP))

Session Classification: Plenary Session

Contribution ID: **87** Type: **not specified**

Welcome Address

Monday 24 April 2023 09:40 (10 minutes)

Presenter: Prof. SUGETA, Atsushi (Executive Vice President (Research), Hiroshima University)

Session Classification: Plenary Session

Contribution ID: **88** Type: **not specified**

Practical Information

Monday 24 April 2023 09:50 (10 minutes)

Presenter: YAMAGUCHI, Yorito (Hiroshima University (JP))

Session Classification: Plenary Session

Contribution ID: **89** Type: **Oral**

sPHENIX (Experiment)

Thursday 27 April 2023 13:50 (25 minutes)

Group or collaboration name

Theory / experiment

Presenter: HACHIYA, Takashi (Nara Women's University (JP))

Session Classification: Plenary Session

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

ALICE 3 (Experiment)

Thursday 27 April 2023 14:15 (25 minutes)

Group or collaboration name

Theory / experiment

Presenter: LIM, Sanghoon (Pusan National university)

Session Classification: Plenary Session

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

J-PARC-HI (Experiment)

Thursday 27 April 2023 14:40 (25 minutes)

Group or collaboration name

Theory / experiment

Presenter: KITAZAWA, Masakiyo

Session Classification: Plenary Session

Contribution ID: **92** Type: **not specified**

Next ATHIC

Thursday 27 April 2023 15:05 (10 minutes)

Session Classification: Plenary Session

Contribution ID: **93** Type: **not specified**

Closing Remark

Thursday 27 April 2023 15:15 (15 minutes)

Presenter: NONAKA, Chiho

Session Classification: Plenary Session

Contribution ID: **94** Type: **Poster**

Probing initial baryon stopping and equation of state with rapidity-dependent directed flow of identified particles

Tuesday 25 April 2023 17:20 (20 minutes)

Using a (3+1)-D hybrid framework with parametric initial conditions, we study $v_1(y)$ of identified particles, including pions, kaons, protons, and lambdas, in Au+Au collisions performed at $\sqrt{s}$ ranging from 7.7 to 200 GeV. The dynamics in the beam direction is constrained using the measured pseudo-rapidity distribution of charged particles and the net proton rapidity distribution. Within this framework, the $v_1(y)$ of mesons is driven by the sideward pressure gradient from the tilted source, and that of baryons mainly due to the initial asymmetric baryon distribution with respect to the beam axis driven by the transverse expansion. Our approach successfully reproduces the rapidity- and beam energy-dependence of v_1 for both mesons and baryons. We find that the $v_1(y)$ of baryons has strong constraining power on the initial baryon stopping, and together with that of mesons, the $v_1(y)$ probes the equation of state of the dense nuclear matter at finite chemical potentials.

Theory / experiment

Theory

Group or collaboration name

Primary author: DU, Lipei (McGill University)

Co-authors: SHEN, Chun (Wayne State University); JEON, Sangyong; Prof. GALE, Charles

Presenter: DU, Lipei (McGill University)

Session Classification: Poster Session

Track Classification: Collective dynamics

Contribution ID: **95** Type: **Poster**

Flavor dependence of jet quenching in heavy-ion collisions

Tuesday 25 April 2023 18:00 (20 minutes)

We investigate the flavor dependent jet quenching, by performing a systematic analysis of medium modifications of the inclusive jet, γ-jet, and b-jet in Pb+Pb collisions relative to those in pp at the LHC. Our results from MadGraph+PYTHIA and LBT well describe the experimental data of the inclusive jet, γ-jet and b-jet both in pp and AA collisions simultaneously. We then use a Bayesian data-driven method to extract systematically the flavor-dependent jet energy loss distributions from experimental data in a model-independent way, where the gluon, light quark and b-quark initialed energy loss distributions are well constrained for the first time. We find that the quark jet energy loss distribution shows weaker centrality and p_T dependence than the gluon initiated one. We demonstrate the relative contributions from the slope of initial spectra, color-charge and parton mass dependent jet energy attenuation to the γ/b-jet suppression in heavy-ion collisions.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr ZHANG, Shan-Liang (Central China Normal University)

Co-authors: ZHANG, Ben-Wei (Central China Normal University); Prof. WANG, Enke (South China Normal University); Dr XING, Hongxi (South China Normal University)

Presenter: Dr ZHANG, Shan-Liang (Central China Normal University)

Session Classification: Poster Session

Track Classification: Jets and medium response

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

Measurement of directed flow at forward and backward pseudorapidity at STAR

Monday 24 April 2023 14:15 (25 minutes)

Directed flow (v_1) describes the collective sideward motion of produced particles and nuclear fragments in heavy-ion collisions. The pseudorapidity (η) dependence of v_1 can provide unique constraints on the initial conditions and dynamical evolution of the Quark Gluon Plasma (QGP). Directed flow in both spectator and participant regions is sensitive to early non-equilibrium dynamics and may provide insights into the baryon stopping mechanism. In 2018, the Event Plane Detector (EPD, $2.1 < |\eta| < 5.1$) was installed in STAR and used for the Beam Energy Scan phase-II (BES-II) data taking. The combination of EPD and high statistics BES-II data enables us to extend the v_1 measurement to a wide η range. In this talk, I will discuss the techniques for measuring v_1 with a scintillator detector like EPD, present v_1 over ten units of η in Au+Au collisions at $\sqrt{s_{NN}} = 27$ GeV and compare the results with the UrQMD model.

Theory / experiment

Experiment

Group or collaboration name

STAR Collaboration

Primary author: LIU, Xiaoyu

Presenter: LIU, Xiaoyu

Session Classification: Parallel Session A

Track Classification: Collective dynamics

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

Jets and medium response (Theory)

Monday 24 April 2023 11:40 (40 minutes)

Presenter: TACHIBANA, Yasuki (Akita International University)

Session Classification: Plenary Session

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

Jets and medium response (Experiment)

Monday 24 April 2023 11:00 (40 minutes)

Presenter: OH, Saehanseul (LBNL)

Session Classification: Plenary Session

Contribution ID: **101** Type: **Oral**

Correlations and fluctuations (Theory)

Tuesday 25 April 2023 10:00 (40 minutes)

Presenter: SAKAI, Azumi

Session Classification: Plenary Session

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

Collective Dynamics (Experiment)

Tuesday 25 April 2023 09:20 (40 minutes)

Presenter: JENA, Chitrasen (National Institute of Science Education and Research (NISER) (IN))

Session Classification: Plenary Session

Contribution ID: **103** Type: **Oral**

Intense field and vorticity (Theory)

Tuesday 25 April 2023 11:40 (40 minutes)

Presenter: YANG, Di-Lun

Session Classification: Plenary Session

Contribution ID: **104** Type: **Oral**

Intense field and vorticity (Experiment)

Tuesday 25 April 2023 11:00 (40 minutes)

Presenter: CHEN, Jinhui

Session Classification: Plenary Session

Contribution ID: **105** Type: **Oral**

Electromagnetic probes (Experiment)

Tuesday 25 April 2023 13:50 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: YANO, Satoshi (Hiroshima University (JP))

Session Classification: Plenary Session

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

QCD phase diagram and extreme states (Theory)

Tuesday 25 April 2023 14:30 (40 minutes)

Group or collaboration name

Theory / experiment

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

Session Classification: Plenary Session

Contribution ID: **107** Type: **Oral**

RHIC-BES program summary (Experiment)

Tuesday 25 April 2023 15:10 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: Dr SINGHA, Subhash (Institute of Modern Physics Chinese Academy of Sciences)

Session Classification: Plenary Session

Contribution ID: **108** Type: **Oral**

QGP in small systems (Theory)

Wednesday 26 April 2023 10:00 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: KANAKUBO, Yuuka (University of Jyväskylä)

Session Classification: Plenary Session

Contribution ID: **109** Type: **Oral**

QGP in small systems (Experiment)

Wednesday 26 April 2023 09:20 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: SEKIGUCHI, Yuko (University of Tokyo (JP))

Session Classification: Plenary Session

Contribution ID: **110** Type: **Oral**

Heavy quarks and quarkonia (Theory)

Wednesday 26 April 2023 11:40 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: ZHAO, Jiaxing (Tsinghua University)

Session Classification: Plenary Session

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

Heavy quarks and quarkonia (Experiment)

Wednesday 26 April 2023 11:00 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: SEO, Jinjoo (Inha University (KR))

Session Classification: Plenary Session

Contribution ID: **112** Type: **Oral**

Machine Learning (Theory)

Thursday 27 April 2023 09:20 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: Dr DU, Yilun (Shandong Institute of Advanced Technology)

Session Classification: Plenary Session

Contribution ID: **113** Type: **Oral**

EIC physics (Theory)

Thursday 27 April 2023 10:00 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: Dr XING, Hongxi (South China Normal University)

Session Classification: Plenary Session

Contribution ID: **114** Type: **Oral**

New theoretical developments (Theory)

Thursday 27 April 2023 11:00 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: YAN, Li (Fudan University)

Session Classification: Plenary Session

Contribution ID: **115** Type: **Oral**

Hadron interactions and exotics (Theory)

Thursday 27 April 2023 11:40 (40 minutes)

Group or collaboration name

Theory / experiment

Presenter: HIYAMA, Emiko

Session Classification: Plenary Session

Contribution ID: **116** Type: **Poster**

Measurements of vector meson mass spectra in pA collisions at J-PARC

Tuesday 25 April 2023 18:00 (20 minutes)

Study of a chiral symmetry in QCD attract wide interests to study the QCD phase diagram. It is theoretically predicted that the chiral symmetry is partially restored at a finite density matter and it can be observed as modifications of vector meson mass spectra. An experiment is being performed at J-PARC to measure mass modifications of vector mesons in a nucleus, which can be considered as a finite baryon density matter. The experiment measures electron-positron decays of vector mesons.
The previous experiment which was performed at KEK-PS shows significant mass modifications in nuclei and the new experiment aims to collect 50 times larger statistics than that of the KEK-PS experiment.
The experiment started constructions of the spectrometer in 2019 and performed acquisitions of pilot-data in 2020 and 2021. In this contribution, the status of the experiment and the performance of the spectrometer will be reported.

Theory / experiment

Experiment

Group or collaboration name

J-PARC E16 collaboration

Primary author: OZAWA, Kyoichiro

Presenter: OZAWA, Kyoichiro

Session Classification: Poster Session

Track Classification: Electromagnetic probes

Contribution ID: **118** Type: **Poster**

Parton splitting scales of reclustered large-radius jets in high-energy nuclear collisions

Tuesday 25 April 2023 17:40 (20 minutes)

We carry out the first theoretical investigation on yields and the hardest parton splitting of large-radius jets reclustered from small radius ($R = 0.2$) anti-k_t jets in Pb+Pb collisions, and confront them with the recent ATLAS measurements.
The Linear Boltzmann Transport (LBT) model is employed for jet propagation and jet-induced medium excitation in the hot-dense medium. We demonstrate that, the large-radius jet production as a function of the splitting scale $\sqrt{d_{12}}$ of the hardest parton splitting is overall suppressed in Pb+Pb relative to p+p collisions due to the reduction of jets yields. A detailed analyses show that the alterations of jet substructures in Pb+Pb also make significant contribution to the splitting scale $\sqrt{d_{12}}$ dependence of the nuclear modification factor R_{AA}. Numerical results for the medium modifications of the jet splitting angle ΔR_{12} and the splitting fraction z are also presented.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr ZHANG, Shan-Liang (Central China Normal University)

Co-authors: ZHANG, Ben-Wei (Central China Normal University); YANG, Mengquan (Central China Normal University)

Presenter: YANG, Mengquan (Central China Normal University)

Session Classification: Poster Session

Track Classification: Jets and medium response

Contribution ID: **119** Type: **Oral**

Substructures of heavy flavor jets in pp and Pb+Pb collisions at $\sqrt{s}$ = 5.02 TeV

Monday 24 April 2023 17:05 (25 minutes)

Groomed jet substructure measurements, the momentum splitting fraction z_g and the groomed jet radius R_g, for inclusive, D^0-tagged and B^0-tagged jets in pp and central Pb+Pb collisions at $\sqrt{s} = 5.02$ TeV are investigated. Theoretical results for light-quark initiated and gluon initiated jets are provided as references. Charged jets are constrained in a relative low transverse momentum interval $15 \leq p_{\mathrm{T}}^{\mathrm{jet\ ch}} < 30$ GeV/c where the QCD emissions are sensitive to mass effects. The mass hierarchy manifests in z_g distributions in both parton showering and jet quenching indicating steeper splitting functions of heavier partons. The competition between flavor effects and mass effects to emission-angle distributions is directly observed for the first time. In both pp and Pb+Pb collisions, the mass hierarchy in R_g of inclusive, D^0-tagged and B^0-tagged jets is broken due to contributions from gluon-initiated jets.

Theory / experiment

Theory

Group or collaboration name

Primary author: ZHANG, Qing (CCNU)

Co-authors: Prof. DAI, Wei (China University of Geosciences); ZHANG, Ben-Wei (Central China Normal University); Prof. WANG, Enke (South China Normal University)

Presenter: ZHANG, Qing (CCNU)

Session Classification: Parallel Session C

Track Classification: Jets and medium response

Contribution ID: **120** Type: **Poster**

Longitudinal momentum fraction of heavy flavor meson in jets in high-energy nuclear collisions

Tuesday 25 April 2023 17:20 (20 minutes)

Heavy flavor jets are powerful tools to gain insight into the in-medium partonic energy loss mechanisms and the transport properties of the quark-gluon plasma (QGP) in high-energy nuclear collisions. In this work, we present the first theoretical study of the longitudinal momentum fraction $z_{||}$ carried by D^0 meson in jets in Pb+Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV. The p+p baseline is provided by POWHEG+PYTHIA8 which matches the next-to-leading order hard processes with the parton shower. The in-medium evolution of heavy quark jets is employed by a Monte Carlo transport model which takes into account the collisional and radiative partonic energy loss in the expanding QGP. In A+A collisions, it is shown that the jet quenching effect would in general decrease the values of $z_{||}$. In addition, we predict visibly stronger nuclear modifications of B^0-jet $z_{||}$ distributions compared to D^0-jet within the same p_{T} windows.

Theory / experiment

Theory

Group or collaboration name

Primary authors: ZHANG, Ben-Wei (Central China Normal University); WANG, Sa (South China Normal University); LI, Yao

Presenter: LI, Yao

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **123** Type: **Oral**

Reaction plane alignment with linearly polarized photon in heavy-ion collisions

Monday 24 April 2023 13:50 (25 minutes)

The collective observables play critical roles in probing the properties of quark-gluon-plasma created in relativistic heavy-ion collisions, in which the information on initial collision geometry is crucial. However, the initial collision geometry, e.g., the reaction plane, cannot be directly extracted in the experiment. In this talk, we demonstrate the idea of determining the reaction plane via the feature of linear polarization of the coherent photoproduction process. We present the theoretical results of the resolution of the reaction plane and discuss the advantages of the proposed approach in comparison with traditional methods. This talk is based on the published article - Phys. Rev. Research 4, L042048.

Theory / experiment

Theory

Group or collaboration name

Primary author: WU, Xin (University of Science and Technology of China)

Co-authors: TANG, Zebo (University of Science and Technology of China); ZHA, wangmei

Presenter: WU, Xin (University of Science and Technology of China)

Session Classification: Parallel Session C

Track Classification: Electromagnetic probes

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

Sub-nucleon geometry and multiparticle cumulants including c2{4} in p+p collisions

Wednesday 26 April 2023 14:40 (25 minutes)

Using the string melting version of a multi-phase transport (AMPT) model without or with the sub-nucleon geometry for the proton to study multiparticle cumulants in p+p collisions at 13 TeV [1]. We have found that both versions of the model can produce c2{4}<0 for high-multiplicity events, which is thought to be the signal of the collective flow. The relation between c2{4} and the parton scattering cross section is non-monotonic, where only a finite range of parton cross sections can lead to negative c2{4} for high-multiplicity p+p events. In addition, the AMPT version with the proton sub-nucleon geometry describes the multiplicity dependence of c2{4} much better than the version without. This demonstrates the importance of incorporating the sub-nucleon geometry and the potential of using multiparticle cumulants to probe the detailed sub-nucleon geometry in studies of small collision systems.

[1] X.L.Zhao, Z.W.Lin, L.Zheng and G.LMa, arXiv:2112.01232.

Theory / experiment

Theory

Group or collaboration name

Primary author: ZHAO, Xinli (Fudan University)

Co-authors: LIN, Zi-Wei (East Carolina University); ZHENG, Liang; MA, Guo-Liang (Fudan University)

Presenter: ZHAO, Xinli (Fudan University)

Session Classification: Parallel Session B

Track Classification: QGP in small systems

Contribution ID: **125** Type: **Poster**

Anisotropic responses of heavy quark potential and diffusion coefficient to the magnetized QGP

Tuesday 25 April 2023 17:20 (20 minutes)

By means of real-time hard thermal loop resummed technique combined with dimension two gluon condensate, we (non-)perturbatively study how the strong magnetic field induced by colliding nuclei affects both heavy quark (HQ) potential and HQ momentum diffusion coefficient in the QGP. We show that HQ momentum diffusion coefficients become anisotropic, and with increasing temperature, the higher Landau levels become significant, which leads to the reduction of the anisotropic ratio (>1) and even overturn the behavior (<1) at high temperature. On the other hand, the anisotropy of the real part of potential is essentially encoded in the string tension. Whereas, the imaginary part of the potential from quark-loop elongates along the magnetic field direction even though using the angular-independent string tension.We also study the viscous quark matter response to magnetic field, then explore such non-equilibrium effect on HQ potential and diffusion coefficient.

Theory / experiment

Theory

Group or collaboration name

Primary author: ZHANG, He-Xia

Co-authors: ZHANG, Ben-Wei (Central China Normal University); Prof. WANG, Enke (South China Normal University)

Presenter: ZHANG, He-Xia

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

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

Measurement of the ϒ production in heavy-ion collisions at the top RHIC energy with the STAR detector

Wednesday 26 April 2023 15:50 (25 minutes)

Measurements of heavy quarkonium in heavy-ion collisions provide a powerful tool to study the properties of the Quark-Gluon Plasma (QGP). Due to the color screening effect, the dissociation of heavy quarkonium was proposed as a direct signature of the QGP formation. Compared to charmonia, bottomonia are cleaner probes because of negligible regeneration contribution at the top RHIC energy. Moreover, different ϒ states are expected to dissociate at different temperatures depending on their binding energies. Measurement of such sequential suppression of the ϒ states can be used to study the QGP's thermodynamic properties.
In this talk, we report the ϒ measurements in Au+Au and isobar (Ru+Ru and Zr+Zr) collisions at $\sqrt{s_{NN}} = 200$ GeV by the STAR experiment. The yields and nuclear modification factors are presented as a function of centrality and transverse momentum. Moreover, the results are compared to those at the LHC as well as theoretical calculations.

Theory / experiment

Experiment

Group or collaboration name

STAR Collaboration

Primary author: YANG, Gaohan (South China Normal University)

Presenter: YANG, Gaohan (South China Normal University)

Session Classification: Parallel Session A

Track Classification: Heavy quarks and quarkonia

Contribution ID: **129** Type: **Poster**

Anisotropic flow of charmonium states in heavy ion collisions

Tuesday 25 April 2023 16:40 (20 minutes)

We discuss anisotropic flow, or elliptic and triangular flow of charmonium states in heavy ion collisions using the coalescence model. Starting from the investigation on transverse momentum distributions of charmonia, we calculate elliptic and triangular flow of charmonium states produced at quark-hadron phase boundary by quark recombination. We argue that the wave function distribution plays a significant role, especially, in the production of charmonium states, leading to the transverse momentum distribution of the $\psi(2S)$ meson as large as that of the J/ψ meson. On the other hand, we find that the wave function effects as well as feed-down contributions are averaged out for elliptic and triangular flow, resulting in similar elliptic and triangular flow for all charmonium states. Based on our evaluation of elliptic and triangular flow of charmonium states we also discuss the quark number scaling of elliptic and triangular flow for charmonium states in heavy ion collisions.

Theory / experiment

Theory

Group or collaboration name

Primary author: CHO, Sungtae

Presenter: CHO, Sungtae

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **130** Type: **Poster**

Charge dependent directed flow of $\pi^{\pm}$, $K^{\pm}$, and $p(\bar{p})$ in Au+Au, $^{96}_{44}$Ru+$^{96}_{44}$Ru, and $^{96}_{40}$Zr+$^{96}_{40}$Zr collisions from STAR

Tuesday 25 April 2023 17:00 (20 minutes)

Strong electromagnetic (EM) field in heavy-ion collisions could leave an imprint on the final-state particles. Due to such EM field, particles and anti-particles with opposite charges will receive opposite contributions to their rapidity-odd directed flow. Here, we present the charge-dependent measurements of dv_1/dy near midrapidity for $\pi^{\pm}$, $K^{\pm}$, and $p(\bar{p})$ in Au+Au and isobar collisions at $\sqrt{s_{NN}}$ = 200 GeV, and in Au+Au at 27 GeV. A clear difference in dv_1/dy between positively and negatively charged hadrons ($\Delta dv_1/dy$) has been observed, and the $\Delta dv_1/d$y changes from positive in central collisions to negative in peripheral collisions for kaons and protons. While the results in central events can be explained by u and d quarks transported from the initial-state nuclei, those in peripheral events reveal contributions from the Faraday induction and Coulomb effect for the first time in heavy-ion collisions.

Theory / experiment

Experiment

Group or collaboration name

STAR

Primary author: SHEN, Diyu

Presenter: SHEN, Diyu

Session Classification: Poster Session

Track Classification: Intense field and vorticity

Contribution ID: **131** Type: **Oral**

High time resolution design of ITOF-mrpc detector in CEE experiment

Wednesday 26 April 2023 17:05 (25 minutes)

The external-target experiment (CEE) is the first large-scale nuclear physics experimental device by China to operate in the fixed-target mode with an energy of ~ 1 GeV. The purpose of the CEE is to study the properties of dense nuclear matter. CEE uses a multi-gap resistive plate chamber (MRPC) as its internal time-of-flight (iTOF) detector for the identification of final-state particles. An iTOF-MRPC prototype with 24 gaps was designed to meet the requirements of CEE, and the readout electronics of the prototype use the FPGA-based time digitization technology. Using cosmic ray tests, the time resolution of the iTOF prototype was found to be approximately 30 ps. In order to further understand how to improve the time resolution of MRPC, ANSYS HFSS was used to simulate the signal transmission process in MRPC. The main factors affecting the timing performance of the MRPC and, accordingly, the optimization scheme are presented.

Theory / experiment

Experiment

Group or collaboration name

CEE

Primary author: Dr HU, Dongdong (University of Science and Technology of China)

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

Session Classification: Parallel Session B

Track Classification: Experimental techniques and future programs

Contribution ID: **132** Type: **Poster**

Unphysical topological charge of nonabelian gauge theory and implications to hadron physics

Tuesday 25 April 2023 16:40 (20 minutes)

We show that the topological charge of nonabelian gauge theory is not observable. We then inspect the phenomenological consequences to hadron physics and experiments such as the physical relevance of the axial U(1) symmetry and the unobservability of the chiral magnetic effect.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr YAMANAKA, Nodoka (KMI, Nagoya University)

Presenter: Dr YAMANAKA, Nodoka (KMI, Nagoya University)

Session Classification: Poster Session

Track Classification: New theoretical developments

Contribution ID: **134** Type: **Poster**

Dynamics of causal hydrodynamic fluctuations in an expanding system

Tuesday 25 April 2023 17:40 (20 minutes)

Since phenomena induced by the hydrodynamic fluctuations include the information of transport coefficients, the study of fluctuations could open up a new way of diagnosing the QGP precisely. We derive equations of motion (EoM) of hydrodynamic fluctuations by considering the perturbative expansion of energy-momentum tensor around the Bjorken's boost invariant solution. These EoMs are derived without any specific forms of constitutive equations. Therefore, one can employ the second order constitutive equations which satisfy the causality. With this framework, we analyze the dynamics of (1+1)D causal hydrodynamic fluctuations and observe streak like structure through the time evolution of energy density. It indicates that the distribution of energy density tends to be frozen during evolution and carries the information of the early stage of evolution. Furthermore, we analyze correlations of fluctuations and find their behaviors are closely related with the properties of the medium.

Theory / experiment

Theory

Group or collaboration name

Primary author: FUJII, Shin-ei (Sophia Univ.)

Co-author: HIRANO, Tetsufumi

Presenter: FUJII, Shin-ei (Sophia Univ.)

Session Classification: Poster Session

Track Classification: Collective dynamics

Contribution ID: **135** Type: **Poster**

The hydrodynamics description of anisotropic flow and flow fluctuations in $\sqrt{s_{NN}}$=5.02 TeV Pb-Pb collisions at the LHC

Tuesday 25 April 2023 17:20 (20 minutes)

Initial state fluctuations and final state anistropic flows have provided powerful tools for studying the evolution dynamics and transport properties of quark-gluon plasma produced in relativistic heavy-ion collisions. The quantitative research on anisotropic flow fluctuations may provide a unique potential to constrain the initial state models of heavy-ion collisions.

In this talk, we present detailed hydrodynamic studies on the flow and flow fluctuations in $\sqrt{s_{NN}}$=5.02 TeV Pb-Pb collisions at the LHC. The elliptic flows and their fluctuations are calculated as a function of transverse momentum and centrality. Our result demonstrates that flow fluctuation is sensitive to the initial state models, especially the granularity of the initial state fluctuations.We further investigate the transverse momentum decorrelation of the flow angle and magnitude and find that their decorrelation is sensitive to initial model and insensitive to transport properties of the QGP.

Theory / experiment

Theory

Group or collaboration name

Primary authors: QIN, Guang-You (Central China Normal University); ZHU, Jie (ccnu); WU, Xiang-Yu

Presenter: ZHU, Jie (ccnu)

Session Classification: Poster Session

Track Classification: Correlations and fluctuations

Contribution ID: **138** Type: **Oral**

Dielectron production in high-multiplicity pp collisions at $sqrt{s} = 13 TeV with ALICE

Monday 24 April 2023 15:05 (25 minutes)

Dielectron production is a powerful tool to investigate the properties of the quark-gluon plasma created in relativistic heavy-ion collisions, as they carry information about the temperature of the medium and its space-time evolution without any distortion due to final-state interactions. If a medium is created in such small colliding systems, it should give rise to an additional contribution of electromagnetic radiation in the direct photon spectrum. For each real direct photon production mechanism, an associated process producing a virtual photon which converts to a low-mass dielectron pair exists as well. These processes, referred to as internal conversions, allow for the measurement of virtual direct photons at low transverse momentum, which is where the thermal radiation signal sits. In this talk, the measurement of virtual photon production in minimum-bias and high-multiplicity pp collisions at $sqrt{s} = 13 TeV using the full ALICE Run 2 dataset will be presented.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary author: MURAKAMI, Hikari (University of Tokyo (JP))

Presenter: MURAKAMI, Hikari (University of Tokyo (JP))

Session Classification: Parallel Session C

Track Classification: Electromagnetic probes

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

Constraining the nuclear equation of state with ellitpic flow in heavy-ion collisions

Monday 24 April 2023 14:40 (25 minutes)

The nuclear equation of state (EOS) plays a crucial role in understanding diverse phenomena in nuclear structure and reactions, as well as in astrophysics. Heavy-ion-collision measurements in combination with transport model simulations serve as important tools for extracting the nuclear EOS. In this talk, I will introduce some results on constraining the nuclear EOS with elliptic flow in heavy-ion collisions at beam energies 0.4A-1.0A GeV, especially some new results from our group by using the ultrarelativistic quantum molecular dynamics (UrQMD) model and the elliptic flow data. In addition, I will also introduce the allpication of machine learning method on the extraction of the nuclear EOS with heavy ion collision.

Theory / experiment

Theory

Group or collaboration name

Primary author: WANG, Yongjia

Presenter: WANG, Yongjia

Session Classification: Parallel Session A

Track Classification: Collective dynamics

Contribution ID: **141** Type: **Poster**

Spin alignment of vector mesons in a rotating medium ⋮ a NJL model study

Tuesday 25 April 2023 17:00 (20 minutes)

Vorticities in heavy-ion collisions (HIC) are supposed to induce spin alignment and polarization phenomena of quarks and mesons. In this paper, we consider a uniformly rotating medium in which quark and anti-quark pairing are suppressed. Consequently, in the framework of Nambu-Jona-Lasinio (NJL) model, dynamical quark masses are descending as the angular velocities grow. In case of vector mesons, mass splitting will emerge among three different spin component $s_z = 0, \pm 1$ along the axis of rotation (z-axis). Furthermore, in a thermal equilibrium system, the difference of mass spectra among $\phi_{s_z=0,\pm 1}$ will cause that vector meson with $s_z = +1$ will be preferred in a rotating medium. Correspondingly, ϕ mesons will be less possible to occupy the $s_z = 0$ state which leads to spin alignment $\rho_{00} < \frac{1}{3}$.

Theory / experiment

Theory

Group or collaboration name

Primary authors: HUANG, Mei; WEI, Minghua (Fudan University)

Presenter: WEI, Minghua (Fudan University)

Session Classification: Poster Session

Track Classification: Intense field and vorticity

Contribution ID: **142** Type: **Oral**

QCD Kondo effect under magnetic catalysis

Wednesday 26 April 2023 16:15 (25 minutes)

We discuss the QCD phase diagram under the effects of heavy quarks and a magnetic field. The effect of the heavy-quark impurity is significantly enhanced by the quantum many-body effect called the QCD Kondo effect within a mean-field theory. Solving the gap equation, we find that the QCD Kondo condensate emerges due to the formations of a pairing between a light quark and a heavy quark. We focus on the competition between the chiral symmetry breaking and the QCD Kondo effect, and show that such a competition induces a quantum critical point separating the two phases. The QCD Kondo effect at vanishing Fermi surface can be studied in the relativistic heavy ion collisions as well as in the Monte Carlo lattice simulations.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr YASUI, Shigehiro (Keio Univ.)

Co-authors: SUENAGA, Daiki (Nagoya University); Dr SUZUKI, Kei (JAEA); HATTORI, Koichi (Zhejiang University)

Presenter: Dr YASUI, Shigehiro (Keio Univ.)

Session Classification: Parallel Session C

Track Classification: QCD phase diagram and extreme states

Contribution ID: **143** Type: **Oral**

Probing the isobaric Ru and Zr nuclear structure with the diffractive photoproduction of ρ mesons

Monday 24 April 2023 14:15 (25 minutes)

The electron scattering process has been used to determine the nuclear charge radius. Similarly, the photon scattering process can be used to determine the nuclear strong-interaction radius, primarily through the diffractive photoproduction of vector mesons. Such an approach has been proven effective at RHIC. The isobar collisions of Ru+Ru and Zr+Zr at RHIC provided an excellent opportunity for studying their nuclear structure. Since Ru and Zr have the same mass number but different atomic numbers, measurement of the Ru and Zr nuclear radii would be sensitive to the nuclear structure parameters, such as the neutron skin and possible deformity. In this presentation, we will report the diffractive photoproduction of ρ mesons in UPCs of Ru+Ru and Zr+Zr at 200 GeV. The ratio of differential cross section $\mathrm{d}\sigma/\mathrm{d}t$ between the two isobar species will be compared with model calculations. Implications of these results on the Ru and Zr nuclear structure will also be discussed.

Theory / experiment

Experiment

Group or collaboration name

STAR collaboration

Primary author: Dr ZHAO, Jie (Fudan University)

Presenter: Dr ZHAO, Jie (Fudan University)

Session Classification: Parallel Session B

Track Classification: Initial state and thermal equilibrium

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

Measurements of light hypernuclei properties and production yields in Au+Au collisions from the STAR experiment

Monday 24 April 2023 16:15 (25 minutes)

Hypernuclei are bound states of nucleons and hyperons. Precise measurements of hypernuclei properties and production yields can shed light on the poorly understood hyperon−nucleon (Y-N) interaction and production mechanisms of hypernuclei.

Thanks to the high statistics data and low collision energies, the STAR beam energy scan phase-II program provides a great opportunity to study hypernuclei production. In this presentation, we will report production yields of ${}^{3}_{\Lambda}\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{H}$ in Au+Au collisions at $\sqrt{s_{NN}}$ = 3, 19.6, and 27 GeV. The strangeness population factors ($\mathrm{S_A} = {}^{\mathrm{A}}_{\Lambda}\mathrm{H}/({}^{\mathrm{A}}\mathrm{He} \times \bar{\mathrm{p}})$), S_3 and S_4, and A=4 hypernuclei yield ratio (${}^{4}_{\Lambda}\mathrm{He}/{}^{4}_{\Lambda}\mathrm{H}$) will also be presented. We will also report precise measurements of ${}^{3}_{\Lambda}\mathrm{H}$ branching ratio and lifetimes of light hypernuclei. The results will be compared with model calculations and physics implications will be discussed.

Theory / experiment

Experiment

Group or collaboration name

the STAR Collaboration

Primary author: LI, Xiujun (USTC)

Presenter: LI, Xiujun (USTC)

Session Classification: Parallel Session B

Track Classification: Hadron interactions and exotics

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

Studies of space-charge distortion corrections using machine learning techniques

Wednesday 26 April 2023 16:40 (25 minutes)

A Large Ion Collider Experiment (ALICE) is an experiment at the Large Hadron Collider (LHC) which aims to understand the most basic properties of Quantum Chromodynamics (QCD) by observing Quark-Gluon Plasma (QGP) created at the center of relativistic heavy-ion collisions. The ALICE detector has been largely upgraded during the LHC Long Shutdown LS2 to become capable of collecting Pb-Pb collision data at an unprecedented interaction rate of 50 kHz. The Time Projection Chamber (TPC) is the main tracking detector of ALICE. Distortions of the electron drift paths caused by ion backflow from the readout chambers significantly affect the TPC measurements and therefore must be fully corrected. The most challenging aspect of the correction is posed by the calibration of distortion fluctuations relevant on time scales in the order of 10 ms. A framework for the distortion fluctuation correction using machine learning techniques is under development and the current status will be discussed.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary author: BABA, Hitoshi (University of Tokyo (JP))

Presenter: BABA, Hitoshi (University of Tokyo (JP))

Session Classification: Parallel Session B

Track Classification: Experimental techniques and future programs

Contribution ID: **146** Type: **Poster**

The jet transport coefficient uncertainties from parton fragmentation functions in heavy ion collisions

Tuesday 25 April 2023 16:40 (20 minutes)

Jet quenching is an important probe to quark-gluon plasma created in high-energy heavy-ion collisions. A significant parameter is known as jet transport coefficient $\hat{q}$ for jet eneygy loss, characterizing the interaction between the parton jet and medium. We study nuclear modification factors of hadron at large p_T in central $A + A$ collisions in a NLO pQCD parton model in which parton fragmentation functions (FFs) are modified due to jet energy loss. We employ 6 sets of current FFs to extract $\hat{q}$ via a global fit to data for both single hadron and dihadron suppressions, and obtain the jet transport coefficient uncertainties. The numerical results show that the significant uncertainties for $\hat{q}/T^3$ extraction are mainly brought by the different contributions of gluon-to-hadron in the different sets of fragmentation function parameterizations due to gluon energy loss being $9/4$ times of quark energy loss.

Theory / experiment

Theory

Group or collaboration name

Primary author: HAN, Qingfei

Co-authors: XIE, man; ZHANG, Hanzhong (IOPP, CCNU)

Presenter: HAN, Qingfei

Session Classification: Poster Session

Track Classification: Jets and medium response

Contribution ID: **147** Type: **Poster**

Jet shape depending on the gradient of jet energy loss in heavy-ion collisions

Tuesday 25 April 2023 17:00 (20 minutes)

Jet shape is studied with a linear Boltzmann transport model for event-by-event simulations of photon-tagged jets in heavy-ion collisions. The transverse momentum asymmetry $A_\perp$ is shown to increase with the initial transverse position when the gradient of jet transport coefficient $\hat{q}$ increases until at the edge of the nonuniform medium. On one hand,the shape of the photon-tagged jet selected by the smaller $A_\perp$ events is "fatter" for the transverse momentum distribution inside the jet due to stronger jet quenching. On the other hand, the jet shape with higher p_T^{jet} is "thinner" due to surface emission of the initial jets. Our numerical results show that the different choices for both final observables $A_\perp$ and p_T^{jet} demonstrate different initial jet creation cites and therefore different jet shapes depending on the gradient of $\hat{q}$.

Theory / experiment

Theory

Group or collaboration name

Primary author: XIAO, Yuxin (CCNU)

Co-authors: Dr HE, Yayun (South China Normal University); PANG, LongGang (Central China Normal University); Dr WANG, Xin-Nian (Lawrence Berkeley National Lab. (US)); ZHANG, Hanzhong (IOPP, CCNU)

Presenter: XIAO, Yuxin (CCNU)

Session Classification: Poster Session

Track Classification: Jets and medium response

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

The direct photon puzzle and the weak magnetic photon emission

Monday 24 April 2023 14:40 (25 minutes)

We propose a novel effect that accounts for the photon emission from a quark-gluon plasma in the presence of a weak external magnetic field. Although the weak magnetic photon emission from quark-gluon plasma only leads to a small correction to the photon production rate, the induced photon spectrum can be highly azimuthally anisotropic, as a consequence of the coupled effect of the magnetic field and the longitudinal dynamics in the background medium. With respect to a realistic medium evolution containing a tilted fireball configuration, the direct photon elliptic flow from experiments is reproduced. In comparison to the experimental data of direct photon elliptic flow, in heavy-ion collisions, the magnitude of the magnetic field at very early stages can be extracted. For the top energy of RHIC collisions, right after the pre-equilibrium evolution, |eB| is found no larger than a few percent of the pion mass square.\[arxiv:2302.07696\]

Theory / experiment

Theory

Group or collaboration name

Primary authors: SUN, Jing-an (Fudan University); YAN, Li (Fudan University)

Presenters: SUN, Jing-an (Fudan University); YAN, Li (Fudan University)

Session Classification: Parallel Session C

Track Classification: Electromagnetic probes

Contribution ID: **151** Type: **Oral**

Influence of quark anomalous magnetic moment on QCD phase diagram under magnetic field

Wednesday 26 April 2023 17:05 (25 minutes)

Several previous studies imply that the quark anomalous magnetic moment (AMM) is dynamically generated through the spontaneous chiral symmetry breaking in the low energy QCD. Even though the exact form of the quark AMM still remains unclear, the AMM would be an essential ingredient for quark matter properties and QCD phase diagram under external magnetic field.
In this talk, I will discuss the quark AMM effect on the chiral phase transition under the magnetic field at finite temperature and chemical potential based on the effective model approach. First, I will deduce the effective form of the AMM to satisfy the observations of the chiral phase transition in the lattice QCD simulations. By using the deduced AMM, I will show the phase diagram of the magnetized quark matter. It is found that the AMM effect significantly affects the phase boundary, and then the first order line shortens. The phenomenological implications of the AMM effect will be also discussed.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr KAWAGUCHI, Mamiya (University of Chinese Academy of Sciences)

Co-author: Prof. HUANG, Mei (University of Chinese Academy of Sciences)

Presenter: Dr KAWAGUCHI, Mamiya (University of Chinese Academy of Sciences)

Session Classification: Parallel Session C

Track Classification: QCD phase diagram and extreme states

Contribution ID: **153** Type: **Oral**

Longitudinal De-correlation of Anisotropic Flow at RHIC-STAR

Monday 24 April 2023 15:05 (25 minutes)

Studies of longitudinal de-correlation of anisotropic flow can provide unique constraints on the three-dimensional structure of the initial stages and dynamical evolution of the quark-gluon-plasma in heavy-ion collisions. Experimentally, the factorization ratio, $r_n(\eta)(n = 2, 3)$, is used to quantify the amount of the longitudinal flow de-correlation with pseudorapidity [1-3]. With data collected by the STAR experiment at RHIC for 200 GeV Ru+Ru and Zr+Zr collisions as well as 19.6, 27, and 54.4 GeV Au+Au collisions, we will present the centrality and collision energy dependence of $r_n(\eta)(n = 2, 3)$. These results can provide new insights into the three-dimensional modeling of the relativistic heavy-ion collisions.

1˜The CMS Collaboration, Phys. Rev. C 92, 034911 (2015).

[2]˜The ATLAS Collaboration, Eur. Phys. J. C 78, 142 (2018).

[3]˜The ATLAS Collaboration, Phys. Rev. Lett. 126, 122301 (2021).

Theory / experiment

Experiment

Group or collaboration name

STAR Collaboration

Primary author: YAN, Gaoguo

Presenter: YAN, Gaoguo

Session Classification: Parallel Session A

Track Classification: Collective dynamics

Contribution ID: **154** Type: **Poster**

Jet quenching effect in heavy ion collision based on AdS/CFT energy loss model

Tuesday 25 April 2023 16:40 (20 minutes)

We employ the AdS/CFT correspondence to study the jet quenching effect in Quark-gluon plasma in heavy-ion collisions.The nuclear modification factor R_{AA} and elliptic flow parameter v_2 are studied in different-centrality collisions at RHIC and LHC.Our numerical results agree with data.Magnetic field and chemical potential of the medium are also considered for the observable evaluations.It is found that magnetic field and chemical potential both enhance the jet energy loss.

Theory / experiment

Theory

Group or collaboration name

Central China Normal University

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

Co-author: Mr ZHANG, Hanzhong (Central China Normal University)

Presenter: Mr ZHU, Liqiang (Central China Normal University)

Session Classification: Poster Session

Track Classification: Jets and medium response

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

Extracting phi meson properties in nuclear matter from pA reactions

Monday 24 April 2023 17:05 (25 minutes)

There is presently no consensus on how the ϕ meson mass and width will change once it is put in a dense environment such as nuclear matter.
While many theoretical works exist, connecting them with experimental measurements remains non-trivial task, as the ϕ meson in nuclear matter is usually produced in relatively high-energy pA reactions, which are generally non-equilibrium processes.
In this presentation, the status of recent theoretical research related to the behavior of the ϕ meson in nuclear matter is reviewed, including works based on QCD sum rules and ongoing transport simulations of pA reactions in which the ϕ meson is produced in nuclei, focusing on observables that will be measured at the J-PARC E16 experiment and related recent measurements at ALICE and HADES.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr GUBLER, Philipp (JAEA)

Presenter: Dr GUBLER, Philipp (JAEA)

Session Classification: Parallel Session B

Track Classification: Hadron interactions and exotics

Contribution ID: **156** Type: **Poster**

Initial conditions in Bjorken expansion from causality

Tuesday 25 April 2023 17:40 (20 minutes)

Relativistic hydrodynamics has been successful in describing space-time evolution of matter created in high-energy nuclear collisions. One conventionally assumes that created matter becomes fluids all at once at a certain initial time. It is, however, not at all trivial from which stage after the collision the fluid picture can be applied. Whether non-linear hydrodynamic equations obey the causality depends on how far the system is away from local thermal equilibrium. Thus, for the system to be causal, initial conditions must be close to the equilibrium state. In this talk, we apply the conditions obtained from causality to the conformal theory in a one-dimensionally expanding system, analyze how far the system can be away from local thermal equilibrium and constrain initial conditions so that the system can obey causality during the evolution. This sheds light on the understanding of initial stages in high-energy nuclear collisions.

Theory / experiment

Theory

Group or collaboration name

Primary author: HOSHINO, Tau (Sophia University)

Co-author: HIRANO, Tetsufumi

Presenter: HOSHINO, Tau (Sophia University)

Session Classification: Poster Session

Track Classification: Collective dynamics

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

Two-point functions from chiral kinetic theory in magnetized plasma

Monday 24 April 2023 15:50 (25 minutes)

We study the two-point functions from chiral kinetic theory which characterize the response to perturbative vector and axial gauge fields in magnetized chiral plasma. In the lowest Landau level approximation, the solution of chiral kinetic equations gives density waves of electric and axial charges, which contain chiral magnetic wave implied by the axial anomaly and magnetic field. We then obtain the constitutive relations for covariant currents and stress tensor that involving the density waves. By considering the difference between consistent and covariant anomalies explicitly, the correlators of consistent currents and stress tensor satisfy derivative symmetry, and therefore allow an effective action for the perturbative gauge fields as the generating functional of the correlators. We also verify the derivative symmetry of the correlators agrees with the Onsager relations.

Theory / experiment

Theory

Group or collaboration name

Primary author: YANG, Lixin (Sun Yat-sen University)

Presenter: YANG, Lixin (Sun Yat-sen University)

Session Classification: Parallel Session A

Track Classification: Correlations and fluctuations

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

Holographic energy loss near critical temperature in an anisotropic background

Wednesday 26 April 2023 14:15 (25 minutes)

We study the energy loss of a quark moving in the strongly coupled $\mathcal{N} = 4$ supersymmetric Yang-Mills (SYM) plasma under the influence of spatial anisotropy. The heavy quark drag force, the diffusion coefficient and the jet quenching parameter are calculated within the Einstein-Maxwell-dilaton model, in which anisotropic background is specified by an arbitrary dynamical exponent A.It is shown that with anisotropic factor A increasing, the drag force and the jet quenching parameter go up, while the diffusion coefficient goes down. We find that the energy loss becomes larger when the quark moving perpendicular to anisotropy direction in transverse plane.The enhancement of drag forces for a fast moving heavy quark as well as jet quenching parameters near critical temperature T_c is observed, which presents one of typical features of QCD phase transition.

Theory / experiment

Theory

Group or collaboration name

Primary author: ZHOU, qi

Co-author: ZHANG, Ben-Wei (Central China Normal University)

Presenter: ZHOU, qi

Session Classification: Parallel Session A

Track Classification: Jets and medium response

Contribution ID: **160** Type: **Poster**

Describing Ridge behavior via kinematics between jets and medium

Tuesday 25 April 2023 17:40 (20 minutes)

The Ridge behavior in high-multiplicity pp collisions has been discussed a lot since it was first reported in year. Because small systems cannot provide sufficient conditions to produce a medium called QGP, in which the ridge behavior is understood with hydrodynamics. In this work, we propose the pure kinematic mechanism between jets and medium partons as tools for describing the Ridge behavior.
In practical calculation, we choose parton distribution functions from the hard scattering model (phPDh) as initial medium parton's distribution. The phPDh is parameterized by a fallout parameter, a, a non-extensive parameter, q, and the temperature of the system, T. Compared to the PYTHIA simulation, we extract proper values of $a = 85$, $q = 1.15$, and $T = 145\,\mathrm{MeV}$. We calculate a two-particle angular correlation using phPDh with various energy losses and angles of jet particles after collisions.

Theory / experiment

Theory

Group or collaboration name

Inha University

Primary authors: YOON, Jin Hee (Inha University (KR)); CHO, Soyeon (Inha University (KR))

Presenter: CHO, Soyeon (Inha University (KR))

Session Classification: Poster Session

Track Classification: Correlations and fluctuations

Contribution ID: **161** Type: **Poster**

Evolution of global polarization in relativistic heavy-ion collisions within a perturbative approach

Tuesday 25 April 2023 17:20 (20 minutes)

Extremely large angular orbital momentum can be produced in non-central heavy-ion collisions,leading to a strong transverse polarization of partons that scatter through the QGP due to spin-orbital coupling.We develop a perturbative approach to describe the formation and spacetime evolution of quark polarization inside the QGP.Polarization from both the initial hard scatterings and interactions with the QGP have been consistently described using the quark-potential scattering approach,which has been coupled to realistic initial condition calculation and the subsequent (3+1)D viscous hydrodynamic simulation of the QGP for the first time.Within this improved approach,we have found that different spacetime-rapidity-dependent initial energy density distributions generate different time evolution profiles of the longitudinal flow velocity gradient,which further lead to an approximately 15% difference in the final polarization of quarks collected on the hadronization hypersurface of the QGP.

Theory / experiment

Theory

Group or collaboration name

Primary authors: LI, Xiaowen; CAO, Shanshan (Shandong University)

Co-authors: DENG, Jian (Shandong University); JIANG, Zefang

Presenter: LI, Xiaowen

Session Classification: Poster Session

Track Classification: Intense field and vorticity

Contribution ID: **162** Type: **Oral**

Initial electromagnetic field dependence of photon-induced production in isobaric collisions at STAR

Monday 24 April 2023 14:15 (25 minutes)

The Lorentz-boosted electromagnetic field, arising from a colliding nucleus, can be treated as a flux of quasi-real photons. Consequent photonuclear ($\propto Z^2$) and photon-photon ($\propto Z^4$) processes could reasonably explain the observed enhancements of J/ψ and e^+e^- pair production at very low transverse momenta (p_T) in peripheral heavy-ion collisions. The STAR experiment collected datasets of $^{96}_{44}$Ru+$^{96}_{44}$Ru and $^{96}_{40}$Zr+$^{96}_{40}$Zr collisions at 200 GeV in 2018, which provide a unique opportunity to study photon-induced processes.

In this presentation, we will compare measurements of J/ψ and e^+e^- pair production at very low p_T in isobaric and Au+Au collisions to study their electromagnetic field dependence. The angular modulation of dielectron pairs will also be presented. Physics implications of these results will be discussed together with model comparisons.

Theory / experiment

Experiment

Group or collaboration name

STAR Collaboration

Primary author: SHEN, Kaifeng

Presenter: SHEN, Kaifeng

Session Classification: Parallel Session C

Track Classification: Electromagnetic probes

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

Nonuniform-temperature effects on the phase transition

Wednesday 26 April 2023 16:40 (25 minutes)

At RHIC, a fireball forms in the Au-Au collision and rapidly cools during expansion, inside which the QCD matter undergoes a phase transition from quark-gluon-plasma to the hadronic phase. The phase transition signals are expected to be observed via the measurements of fluctuations of conserved charges such as baryon numbers 1. As the realistic fireball is a temporally fast evolving and spatially highly nonuniform system, both the dynamical evolution and the spatially-nonuniform-temperature (and chemical potential) distribution should affect the fluctuations of QCD phase transition.
In this talk, based on the local equilibrium assumption and the Markov assumption, we will present the spatially-nonuniform-temperature effects on the QCD phase transition temperature, the fluctuations, and the correlation length via a simplified Ising-like model [3]. Different from the dynamical effects, which delay the phase transition, we reveal that the nonuniform-temperature effects lead to higher phase transition temperature. Besides, the suppression of the critical fluctuations can be as stronger as the dynamical slowing down effects, in which the nonzero-momentum modes of fluctuations play a crucial role.

1 J. Adamet al. (STAR Collaboration), Phys. Rev. Lett.126,092301 (2021).
[2] M. Stephanov and Y. Yin, Phys. Rev. D98, 036006 (2018).
[3] Jun-Hui Zheng and Lijia Jiang, Phys. Rev. D 104, 016031 (2021)

Theory / experiment

Theory

Group or collaboration name

Primary authors: Prof. ZHENG, JUNHUI (Northwest University); Dr JIANG, Lijia (Northwest University)

Presenter: Dr JIANG, Lijia (Northwest University)

Session Classification: Parallel Session C

Track Classification: QCD phase diagram and extreme states

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

Overview of recent charmonium measurements with ALICE at the LHC

Wednesday 26 April 2023 16:40 (25 minutes)

Charmonia are excellent probes of deconfinement in heavy-ion collisions. Due to different binding energies between J/ψ and ψ(2S),the hot nuclear matter effects have different impact on the production yields of the ground and excited states. The measurements of the J/ψ and ψ(2S) in the same collision system will give an insight to the charmonium production mechanisms in the heavy-ion collisions.

In this talk, I will review the recent charmonium measurements with ALICE, J/ψ and ψ(2S), in Pb–Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV. The nuclear modification factors for inclusive as well as prompt and non-prompt J/ψ will be shown as a functions of p_T and centrality at midrapidity. The newly published results on ψ(2S) will also be presented. In addition, I will discuss the recently published results on J/ψ polarization with respect to a quantization axis orthogonal to the event-plane.

Theory / experiment

Experiment

Group or collaboration name

ALICE Collaboration

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

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

Session Classification: Parallel Session A

Track Classification: Heavy quarks and quarkonia

Contribution ID: **166** Type: **Oral**

Production of molecular structure hadron in heavy ion collision

Monday 24 April 2023 16:40 (25 minutes)

We calculate the yields of molecular configuration hadrons produced by heavy ion collision using coalescence model. First, we calculated the transverse momentum distribution of deuteron using the coalescence model from proton transverse momentum distribution in Pb-Pb collisions at 2.76TeV measured by ALICE collaboration. From this, we estimate the parameters required for coalescence model at coalescence point. We then calculate the transverse momentum distribution of helium-3 using this parameter and compared with the experimental results by ALICE collaboration to confirm that parameterization was successful. After this, we assume that X(3872) and Tcc are loosely bounded molecular structures and estimate the transverse momentum distributions and yields of these using coalescence model. Additionally, we compare the transverse momentum distribution of molecular structure and compact 4-quark state and discuss how we can know the structure of X(3872) and Tcc.

Theory / experiment

Theory

Group or collaboration name

Primary authors: Mr YUN, Hyeongock (Yonsei University); Prof. LEE, Su Houng (Yonsei University)

Co-authors: HONG, Juhee (Yonsei University); Prof. LIM, Sanghoon (Pusan National university); CHO, Sungtae; Prof. KIM, Yongsun (Sejong University)

Presenter: Mr YUN, Hyeongock (Yonsei University)

Session Classification: Parallel Session B

Track Classification: Hadron interactions and exotics

Contribution ID: **167** Type: **Oral**

Application of the Momentum Kick Model with multiplicity dependence to the pp collisions at 13 TeV at the LHC

Wednesday 26 April 2023 14:15 (25 minutes)

Previously, the ridge phenomenon in heavy-ion collisions such as PbPb has been well described by hydrodynamic models. However, the ridge structure of a small system, such as pp collisions, which could not offer enough conditions to create the medium required by hydrodynamic models, was observed in high-multiplicity events. This is why we focus on the Momentum Kick Model (MKM), which explains the ridge phenomenon through the kinematic process. Moreover, since the ridge yields depend on multiplicity in high-energy collision experiments, C. Y. Wong developed the MKM with multiplicity via an impact parameter, a noteworthy success in the CMS pp at 7 TeV.
Recently, the multiplicity-dependent ridge structure was observed in the CMS pp at 13 TeV, revealing two peculiarities of the ridge yields: the proportionality with the multiplicity and the maximum yield at the middle range of the pT region. To check the validity of the MKM, we apply this model with multiplicity to this CMS data.

Theory / experiment

Theory

Group or collaboration name

Inha University

Primary authors: YOON, Jeongseok (Inha University (KR)); YOON, Jin Hee (Inha University (KR))

Presenter: YOON, Jeongseok (Inha University (KR))

Session Classification: Parallel Session B

Track Classification: QGP in small systems

Contribution ID: **168** Type: **Poster**

The Fox-Wolfram Moment of jet production in relativistic heavy ion collisions

Tuesday 25 April 2023 17:20 (20 minutes)

We study the first-order Fox-Wolfram moment H_1^T in relativistic heavy-ion collisions, where jet productions in p + p are simulated within a Monte Carlo event generator SHERPA 2.2.11, and the jet propagation in medium with the Linear Boltzmann Transport (LBT) model. Because of jet quenching effect, a suppression of the distribution at small H_1^T region and an enhancement at large H_1^T region are observed for 2-jet events in Pb + Pb collisions as compared to their p + p reference, whereas for the ≥ 3 jets events, we see the suppressions both in the small and large H_1^T regions. The nuclear modification factor for H_1^T of ≥ 2 jet events is also presented, which is smaller than unity with the small H_1^T but larger than one at large H_1^T. The underlying reason for this novel behavior is also discussed.

Theory / experiment

Theory

Group or collaboration name

Primary author: KONG, WeiXi

Co-author: ZHANG, Ben-Wei (Central China Normal University)

Presenter: KONG, WeiXi

Session Classification: Poster Session

Track Classification: Jets and medium response

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

Probing novel baryonic Spin Hall Effect via measurement of local spin polarization of \mathbf{\Lambda} hyperons in STAR Beam Energy Scan

Monday 24 April 2023 14:40 (25 minutes)

The Spin Hall Effect (SHE) is instrumental in investigating quantum effects in many-body systems. Recently,theoretical calculations indicate that the gradient of baryonic chemical potential (analogous to the electric field) can induce a sizable spin Hall current. At the RHIC Beam Energy Scan (BES) energies, the sign as well as the pattern of energy dependence of the difference in the second harmonic coefficient between polarization of Λ and Λ-bar hyperons,could be significantly different with and without the baryonic spin Hall current.In this talk, we will present the first measurement of second harmonic coefficients of Λ hyperons'spin polarization ($\frac{}{x}^{-bar}sin(2)$, $\frac{}{y}^{-bar}cos(2)$ and $\frac{}{z}^{-bar}sin(2)$,where $= -_2$) as a function of transverse momentum,rapidity,and collision centrality in RHIC BES-II Au+Au collisions at √sNN = 14.6,19.6 and 27 GeV. This can serve as the first probe of the baryonic SHE in heavy-ion collisions.

Theory / experiment

Experiment

Group or collaboration name

STAR

Primary author: HU, Qiang

Presenter: HU, Qiang

Session Classification: Parallel Session B

Track Classification: Intense field and vorticity

Contribution ID: **171** Type: **Poster**

Development of the ALICE FoCal-E pad detector

Tuesday 25 April 2023 16:40 (20 minutes)

The ALICE Collaboration is planning to install a new forward calorimeter (FoCal) as a detector upgrade to the ALICE experiment at LHC during the next long shutdown from 2027 to 2029. FoCal consists of the Si+W electromagnetic and conventional sampling hadronic subsystems (FoCal-E and FoCal-H, respectively), and it will cover the pseudorapidity interval of $3.4 < \eta < 5.8$ at a place of 7 meters in the forward region seen from the interaction point. FoCal-E has 18 low-granularity layers with silicon pad sensors and 2 high-granularity layers with silicon pixel sensors. In this talk, we report recent activities to develop the FoCal-E pad layers in Japan including I-V and C-V characteristics of p-sub and n-sub silicon pad sensors under the temperature range from 20 to 50 degrees C and new results of the irradiation test at RIKEN RANS and beam test at ELPH.

Theory / experiment

Experiment

Group or collaboration name

The ALICE Collaboration

Primary author: INABA, Motoi (Tsukuba University of Technology)

Presenter: INABA, Motoi (Tsukuba University of Technology)

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **172** Type: **Poster**

Scaling behaviors of heavy flavor meson suppression and flow in different nuclear collision systems at the LHC

Tuesday 25 April 2023 17:00 (20 minutes)

We explore the system size dependence of heavy-quark-QGP interaction by studying the HF meson suppression and elliptic flow in four different collisions at the LHC. Within an advanced Langevin-hydrodynamics framework, we provides a reasonable description of the D meson RAA and v2 in Pb-Pb collisions, as well as predictions for both D and B meson observables in other collision systems yet to be measured. We find a clear hierarchy for the heavy meson suppression with respect to the size of the colliding nuclei, while their v2 relies on both the system size and the geometric anisotropy of the QGP. Sizable suppression and flow are predicted for both D and B mesons in O-O collisions, which serve as a crucial bridge of jet quenching between large and small collision systems. Scaling behaviors between different collision systems are shown for the heavy meson RAA, and the bulk eccentricity rescaled heavy meson v2, both as functions of the number of participant nucleons in heavy-ion collisions.

Theory / experiment

Theory

Group or collaboration name

Primary authors: LI, Shu-Qing; XING, Wen-Jing (Shandong university); WU, Xiang-Yu; CAO, Shanshan (Shandong University); QIN, Guang-You (Central China Normal University)

Presenter: LI, Shu-Qing

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **173** Type: **Poster**

Flow measurements via long-range two-particle correlations in small systems with ALICE

Tuesday 25 April 2023 17:00 (20 minutes)

In relativistic heavy-ion collisions, a hot and dense medium called QGP is created. Intriguingly, the collective motion of produced particles, which is thought to be evidence of the formation of strongly interacting QGP, has also been observed in high-multiplicity events of small systems like pp and p–Pb collisions. In addition, studying the flow of identified particles with different masses and quark contents may reveal whether collectivity is built on a partonic level. In the ALICE experiment with an excellent capability of particle identification, the study of collectivity in small systems has been conducted via long-range two-particle correlations, and a detailed study of non-flow subtraction has been performed.

In this talk, we will present the recent measurements of anisotropic flow of unidentified and identified hadrons in pp collisions at 13 TeV and p–Pb collisions at 5.02 TeV with ALICE Run 2 data, and comparison with PYTHIA8 and AMPT models for further discussion.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary author: JI, Su-Jeong (Pusan National University (KR))

Presenter: JI, Su-Jeong (Pusan National University (KR))

Session Classification: Poster Session

Track Classification: QGP in small systems

Contribution ID: **175** Type: **Poster**

Covariant chiral kinetic equation in non-Abelian gauge field from "covariant gradient expansion"

Tuesday 25 April 2023 17:00 (20 minutes)

We derive the chiral kinetic equation in 8 dimensional phase space in non- Abelian SU(N) gauge field within the Wigner function formalism. By using the "covariant gradient expansion", we disentangle the Wigner equations in four-vector space up to the first order and find that only the time-like component of the chiral Wigner function is independent. After color decomposition, we present the non-Abelian covariant chiral kinetic equation for the color singlet and multiplet phase-space distribution functions. These phase-space distribution functions have non-trivial Lorentz transformation rules when we define them in different reference frames. The chiral anomaly from non-Abelian gauge field arises naturally from the Berry monopole in Euclidian momentum space in the vacuum or Dirac sea contribution. The anomalous currents as non-Abelian counterparts of chiral magnetic effect and chiral vortical effect have also been derived from the non-Abelian chiral kinetic equation.

Theory / experiment

Theory

Group or collaboration name

Primary author: LUO, Xiaoli

Presenter: LUO, Xiaoli

Session Classification: Poster Session

Track Classification: QCD phase diagram and extreme states

Contribution ID: **176** Type: **Poster**

Covariant chiral kinetic equation in non-Abelian gauge field from "covariant gradient expansion"

Tuesday 25 April 2023 17:20 (20 minutes)

We derive the chiral kinetic equation in 8 dimensional phase space in non- Abelian SU(N) gauge field within the Wigner function formalism. By using the "covariant gradient expansion", we disentangle the Wigner equations in four-vector space up to the first order and find that only the time-like component of the chiral Wigner function is independent. By color decomposition, we present the non-Abelian covariant chiral kinetic equation for the color singlet and multiplet phase-space distribution functions. These phase-space distribution functions have non-trivial Lorentz transformation rules when we define them in different reference frames. The chiral anomaly from non-Abelian gauge field arises naturally from the Berry monopole in Euclidian momentum space in the vacuum or Dirac sea contribution. The anomalous currents as non-Abelian counterparts of chiral magnetic effect and chiral vortical effect have also been derived from the non-Abelian chiral kinetic equation.

Theory / experiment

Theory

Group or collaboration name

Primary author: LUO, Xiaoli

Presenter: LUO, Xiaoli

Session Classification: Poster Session

Track Classification: Intense field and vorticity

Contribution ID: **178** Type: **Poster**

Study of jet fragmentation in ALICE

Tuesday 25 April 2023 17:00 (20 minutes)

Jets provide unique and powerful probes to study Quantum Chromodynamics in proton-proton collisions and the quark-gluon plasma medium in heavy-ion collisions. Among these probes, measurement of jet substructure and of the distribution of hadronic constituents within a jet provide a detailed look into the partonic shower process. ALICE has recently measured and published transverse momentum (j_{T}) distributions of the jet fragments in proton-proton and proton-lead collisions. Further follow-up analysis is done to separate two components related to jet fragments and hadronisation. The study has been extended to j_{T} measurements in different momentum fraction z ranges for a more detailed look. In this talk, the latest results on measurements of transverse momentum of charged-particle jet fragments in pp collisions by the ALICE Collaboration will be presented. The results are compared with various models to test our understanding of jet fragmentation.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary author: RYU, Jaehyeok (Pusan National University (KR))

Presenter: RYU, Jaehyeok (Pusan National University (KR))

Session Classification: Poster Session

Track Classification: Jets and medium response

Contribution ID: **179** Type: **Poster**

Beam test studies of silicon sensors for ALICE ITS3

Tuesday 25 April 2023 16:40 (20 minutes)

During the Long Shutdown 3 (2026-2028) at LHC, ALICE is planning to replace the innermost three layers of the existing inner tracking system (ITS2) with a new silicon detector (ITS3) which is under development. ITS3 is based on truly cylindrical half barrels using wafer-scale monolithic active pixel sensors reducing the material budget and significantly. Thus, ITS3 will improve the trajectory and vertex measurement precision of charged particles. Various prototype silicon sensors have been produced and tested with existing ALPIDE and DPTS chips to evaluate their performance in test beams at PS, SPS, and DESY. In this presentation, we will introduce the test beam of prototype silicon sensors for the ITS3 and present the initial results using bent ALPIDE sensors and DPTS (Digital Pixel Test Structure) sensors.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary author: JANG, Hangil (Pusan National University (KR))

Presenter: JANG, Hangil (Pusan National University (KR))

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **180** Type: **Poster**

Investigation of the initial geometry description using collectivity in the AMPT model

Tuesday 25 April 2023 16:40 (20 minutes)

The motivation of geometry engineering with p, d, and 3He projectiles at RHIC is to investigate the relation between initial geometry and final momentum anisotropy, which is thought to be strong evidence of QGP. PHENIX results show the elliptic and triangular flow hierarchy in p/d/3He+Au collisions follows the eccentricity described by the MC Glauber model. However, the initial geometry of small systems is sensitive to detailed descriptions such as sub-nucleon geometry, area of energy deposition, and elastic scattering. A multiphase transport model (AMPT) can qualitatively describe the collective behavior with scatterings at partonic and hadronic stages. We utilize the AMPT to simulate small systems and investigate the correlation between initial geometry and final momentum anisotropy with different geometry descriptions. We will present the study on the relationship between the flow coefficient of produced particles and the eccentricity of initial geometry with various configurations.

Theory / experiment

Experiment

Group or collaboration name

Primary author: LIM, Hyunji (Pusan National University (KR))

Co-author: LIM, Sanghoon (Pusan National university)

Presenter: LIM, Hyunji (Pusan National University (KR))

Session Classification: Poster Session

Track Classification: QGP in small systems

Contribution ID: **181** Type: **Poster**

Heavy meson-nucleon molecules in the meson exchange model

Tuesday 25 April 2023 16:40 (20 minutes)

Hadron interactions are important for understanding the hadron composite states such as exotic hadrons and hadronic nuclei. However natures of hadron interactions are still poorly understood. In recent years, lattice QCD analysis and measurements of correlation functions in heavy-ion collisions have provided information on the heavy hadron interactions.

In this work, we investigate the interaction of open heavy meson ($P = \bar{D}, B$) and nucleon. The PN system is in a genuine exotic pentaquark channel with $\bar{Q}qqqq$. In 2022, ALICE collaboration reported the pD^- correlation function which agrees with the attractive interaction models. We construct the hadron interaction based on the CD-Bonn model, being one of the realistic nuclear force, and the heavy hadron effective lagrangian respecting to the heavy quark symmetry. We discuss the PN bound state and a role of our model interactions. We also discuss the heavy quark spin multiplet structure in obtained energy spectra.

Theory / experiment

Theory

Group or collaboration name

Primary author: YAMAGUCHI, Yasuhiro

Co-authors: HOSAKA, Atsushi; Dr YASUI, Shigehiro (Keio Univ.)

Presenter: YAMAGUCHI, Yasuhiro

Session Classification: Poster Session

Track Classification: Hadron interactions and exotics

Contribution ID: **182** Type: **Poster**

Directed flow of light flavor hadrons

Tuesday 25 April 2023 17:20 (20 minutes)

Experimentally observed splitting of directed flow (v_1) between proton and anti-proton has been a challenging observable for the models to describe. We propose a two-component baryon deposition scheme driven by participants as well as binary collision sources. Evolving such a profile through a hybrid framework (hydrodynamics + hadronic transport), we are able to capture the v_1 of light flavor hadrons along with the splitting of v_1 between baryon and anti-baryon across beam energies ranging from $\sqrt{s_{NN}} = 200$ GeV to 7.7 GeV. We further demonstrate that recent STAR measurements of centrality dependence of v_1 split of oppositely charged hadrons that is expected to be signals of electromagnetic field receive large background contribution from the physics of baryon stopping.

Theory / experiment

Theory

Group or collaboration name

Primary authors: CHATTERJEE, Sandeep (IISER, Berhampur); Mr PARIDA 1820502, Tribhuban

Presenter: CHATTERJEE, Sandeep (IISER, Berhampur)

Session Classification: Poster Session

Track Classification: Collective dynamics

Contribution ID: **183** Type: **Poster**

Forward muon track reconstruction between multiple detectors using machine learning in ALICE Run 3

Tuesday 25 April 2023 17:00 (20 minutes)

A new detector was installed in ALICE in the forward region during LHC LS2 with the aim to improve the accuracy of the dimuon opening angle measurement more than ever since the LHC Run 3. Such new detector cannot identify muons and measure their momentum, so it must be used in combination with an existing detector. Therefore, it is necessary to correctly match the tracks reconstructed by each detector. However, the huge amount of tracks due to high-multiplicity events such as HIC and the Coulomb multiple scattering inside the thick layer of material between the new and existing detectors for muon identification pose challenges. In this talk, we will show how machine learning can be used to correctly match these tracks and evaluate their performance using purity and efficiency. We will also discuss results obtained applyng machine learning techniques to the reconstruction of the invariant mass distributions.

Theory / experiment

Experiment

Group or collaboration name

ALICE Collaboration

Primary author: Mr EJIMA, Ren (Hiroshima University (JP))

Presenter: Mr EJIMA, Ren (Hiroshima University (JP))

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **184** Type: **Oral**

Spin-shear coupling revisted from collisional quantum kinetic theory

Wednesday 26 April 2023 16:15 (25 minutes)

The global spin polarization of Lambda hyperon in heavy ion collisions has been well described by spin-vorticity coupling, serving as an evidence for creation of rapid spinning quark-gluon plasma. However the same picture fails to explain the measurement of local spin polarization. It has been realized recently that shear stress also couples to spin polarization, and phenomenologial studies point to the same trend as the experimental result. We point out the present theoretical input in phenomenological studies is incomplete for ignoring the collisional effect, which is crucial for distinguishing spin-shear coupling and spin-vorticity coupling. We present a more complete result based on quantum kinetic theory 1, indicating enhancement of spin-shear coupling [2,3].

1Shu Lin, Phys.Rev.D 105 (2022) 7, 076017
[2]Shu Lin and Ziyue Wang, JHEP 12 (2022) 030
[3]Shu Lin and Ziyue Wang, to appear

Theory / experiment

Theory

Group or collaboration name

Primary authors: LIN, Shu; WANG, Ziyue (Tsinghua University)

Presenter: LIN, Shu

Session Classification: Parallel Session B

Track Classification: New theoretical developments

Contribution ID: **185** Type: **Poster**

Possible enhancement of dilepton production and transport coefficients due to the QCD phase transitions at high density

Tuesday 25 April 2023 17:40 (20 minutes)

We study how the dilepton production rate (DPR) and the associated transport coefficients, the electric conductivity and relaxation time, are affected by the soft modes of the QCD critical point (CP) and the color superconducting (CSC) phase transition. We examine the modification of the photon self-energy by the so-called Aslamazov-Larkin, Maki-Thompson, and Density of States terms on the basis of the two-flavor NJL model. We find that the DPR is significantly enhanced in the low invariant mass region around the QCD CP and CSC phase transition, which can be promising observables to reveal the existence of the respective phase transitions by heavy-ion collision experiments. Moreover, it is shown that electric conductivity and relaxation time are divergent at the respective critical temperatures with different exponents and the physical origin of the difference is clarified in terms of the characteristics of the respective soft modes.

Theory / experiment

Theory

Group or collaboration name

Primary author: NISHIMURA, Toru

Co-authors: KITAZAWA, Masakiyo; KUNIHIRO, Teiji (Kyoto University)

Presenter: NISHIMURA, Toru

Session Classification: Poster Session

Track Classification: Electromagnetic probes

Contribution ID: **186** Type: **Poster**

Study of multiplicity-dependent charmonia production in p + p collisions with PHENIX

Tuesday 25 April 2023 17:40 (20 minutes)

The production of quarkonia in high-energy heavy-ion collisions has been studied extensively to understand their production mechanisms and properties of QGP. Recent PHENIX studies show that the increasing J/ψ yields versus multiplicity in p+p collisions are similar to results in different J/ψ acceptance and collision energy, implying that MPI contributes to J/ψ production at RHIC energy. The ψ(2S) has the same quark contents as J/ψ but different binding energy, so they are expected to be modified differently due to the final-state effect, like interaction with nuclear mediums or co-moving particles. Such effects would be significant even in small systems like p+A collisions; thus, understanding the modification mechanism is crucial to describing quarkonia production in different multiplicity ranges. This talk will present the analysis status and recent PHENIX measurements. We will also discuss comparisons with other experimental results and PYTHIA8.

Theory / experiment

Experiment

Group or collaboration name

Primary author: OH, Jongho (Pusan National University (KR))

Presenter: OH, Jongho (Pusan National University (KR))

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **188** Type: **Poster**

Dimuon production at low transverse momentum in peripheral Au+Au collisions at 200 GeV at STAR

Tuesday 25 April 2023 17:40 (20 minutes)

The strong electromagnetic field generated by the colliding nuclei in heavy-ion collisions can be represented by a spectrum of photons leading to photon-induced interactions. While such interactions are traditionally studied in ultra-peripheral collisions (UPC), significant enhancements of dilepton pairs and J/ψ production at very low transverse momentum (p_{T}) above the expected hadronic interaction yields have been observed experimentally in non-UPC events. The observed excess yields are consistent with photon-induced interactions.

In 2014 and 2016, the STAR experiment recorded large samples of Au+Au collisions at 200 GeV. In this contribution, we will present new measurements of very low p_{T} dilepton and J/ψ production in peripheral Au+Au collisions via the $\mu^{+}\mu^{-}$ channel using these datasets. These measurements are complementary to the previous dielectron results. Physics implications will also be discussed together with model comparisons.

Theory / experiment

Experiment

Group or collaboration name

STAR collaboration

Primary author: LI, Ziyang

Presenter: LI, Ziyang

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **189** Type: **Poster**

Feasibility study of ultra-intense magnetic field detection via virtual photon derived dimuon polarization in ALICE Run 3

Tuesday 25 April 2023 16:40 (20 minutes)

In non-central high-energy nuclear collision, very strong magnetic field is produced. High intensity magnetic field have never been directly detected experimentally, and we propose to measure virtual photon polarization as direct evidence. Since anisotropy appears in the lepton pair decay plane of a virtual photon polarized by a magnetic field, we aim to detect virtual photon polarization by quantifying and measuring it.
The purpose of this study is to evaluate, using simulations, whether virtual photon polarization can be detected in lead nucleus collisions in ALICE Run 3. The data were produced separately for the underlying event and for polarized μ-particle pairs, which were then combined into the single data set.
The polarization is observed with a good significance in the current simulation setting. I am currently in the process of running simulations to match the estimated statistics and the signal to background ratio at ALICE Run 3. I will show the latest result of the study.

Theory / experiment

Experiment

Group or collaboration name

ALICE Collaboration

Primary author: MURAOKA, Shunichiro (for ALICE Collaboration)

Presenter: MURAOKA, Shunichiro (for ALICE Collaboration)

Session Classification: Poster Session

Track Classification: Intense field and vorticity

Contribution ID: **191** Type: **Poster**

Hydrodynamic simulation of dilepton production with chiral symmetry restoration scenario

Tuesday 25 April 2023 16:40 (20 minutes)

We investigate the effect of chiral symmetry restoration on dilepton invariant mass spectra measured in high-energy heavy-ion collisions. The hadron properties such as the hadron spectra change when the chiral symmetry restores in the hot medium created in high-energy heavy-ion collisions. We analyze the dilepton invariant mass spectra with hadron spectra obtained from different chiral symmetry restoration scenarios focusing on the chiral mixing.

In our study, we run a hydrodynamic simulation with temperature dependent shear and bulk viscosities. We integrate the thermal dilepton and dilepton from the hadron spectral function to obtain the final dilepton invariant mass spectra. For the chiral symmetry restoration scenario, we compare the low energy mixing theorem and the vector-axial-vector mixing from a chiral effective field theory. We compare the invariant mass spectra from hadron spectral function with and without the chiral mixing and discuss the effect of chiral symmetry restoration from each scenario.

Theory / experiment

Theory

Group or collaboration name

Primary authors: SAKAI, Azumi; Prof. HARADA, Masayasu (Nagoya Univ); NONAKA, Chiho; SASAKI, Chihiro; SHIGAKI, Kenta (Hiroshima University (JP)); YANO, Satoshi (Hiroshima University (JP))

Presenter: SAKAI, Azumi

Session Classification: Poster Session

Track Classification: Electromagnetic probes

Contribution ID: **192** Type: **Poster**

Measurements of weak boson production via electrons in pp collisions at $\sqrt{s} = 13$ TeV with ALICE

Tuesday 25 April 2023 17:40 (20 minutes)

Measurements of weak bosons, $W^{\pm}$ and Z^{0}, are powerful tools to study quantum chromodynamics (QCD). Due to their large masses, they are predominantly produced via quark-antiquark annihilation in the early stage of pp and heavy-ion collisions. Therefore, their production can be described by the perturbative QCD (pQCD) and is sensitive to the parton distribution function in nucleon and nucleus.

In this presentation, a measurement of the p_{T}-differential cross section for $W^{\pm}$ bosons via their leptonic decay at midrapidity ($|\eta| < 0.6$) in pp collisions at $\sqrt{s} = 13$ TeV is presented. In addition, the production cross section for Z^{0} bosons reconstructed by electron-positron pairs will be shown. The production of $W^{\pm}$ measured as a function of the charged-particle multiplicity in pp collisions together with the associated hadrons is also shown. The results are compared with a prediction based on pQCD calculations.

Theory / experiment

Experiment

Group or collaboration name

ALICE collaboration

Primary author: SAKAI, Shingo (University of Tsukuba (JP))

Presenter: SAKAI, Shingo (University of Tsukuba (JP))

Session Classification: Poster Session

Track Classification: Electromagnetic probes

Contribution ID: **193** Type: **Poster**

Feasibility of $\rho(770)^0 \to \pi\pi$ measurement with standalone MFT tracks with ALICE

Tuesday 25 April 2023 17:20 (20 minutes)

The short-lived resonances are sensitive probes of the hadronic phase whose lifetime is several fm/c in heavy-ion collisions. The final state yields are expected to be affected by re-scattering and regeneration after chemical freeze-out. The measured yield of resonances tends to be suppressed by the re-scattering of daughter particles with other hadrons. On the other hand, it tends to be increased by regeneration due to pseudo-elastic scattering processes. The cumulative effect depends, among other parameters, on the lifetime of the hadronic phase and the resonance and medium density. The production of $K^*(892)^0$, $\Lambda(1520)$ and $\rho(770)^0$ at midrapidity has been observed consistent with prediction including these effects in the hadronic phase. At ALICE, charged particles can be detected in the forward region with the Muon Forward Tracker (MFT) which is installed in front of the absorber for the Run 3 data taking and covering $-3.6 < \eta < -2.5$. $\rho(770)^0 \to \pi\pi$ is expected to be measured in the forward region using MFT. The production of $\rho(770)^0$ in the forward region will provide further insight into the processes in the hadronic phase.

In this talk, we will present the feasibility of measuring $\rho(770)^0 \to \pi\pi$ using MFT in pp, assuming that all particles injected into MFT are pions.

Theory / experiment

Experiment

Group or collaboration name

the ALICE collaboration

Primary author: KIMURA, Kento (Hiroshima University (JP))

Presenter: KIMURA, Kento (Hiroshima University (JP))

Session Classification: Poster Session

Track Classification: Hadron interactions and exotics

Contribution ID: **196** Type: **Poster**

Performance of ALICE Forward Calorimeter E-Pad using hadron and electron beams at SPS

Tuesday 25 April 2023 17:20 (20 minutes)

We are developing a Forward Calorimeter (FoCal) as one of the proposed ALICE upgrade projects at CERN. The FoCal extends the scope of ALICE, which was designed for the comprehensive study of hot and dense partonic matter, by adding new capabilities to explore the small-x region in parton distribution for nucleons and nuclei.

The electromagnetic calorimeter (FoCal-E) equipped with 18 pad readout and 2 pixel layers and the hadronic calorimeter (FoCal-H) have been tested in high energy particle beams at the CERN SPS in November 2022. The primary objective was the validation of the pad ASICs and of the read-out electronics, and to quantify the performance of the individual and combined sub-systems of the FoCal.

In this presentation we will be given an overview of the FoCal prototypes tested in beam in 2021 and 2022 and show the most recent results.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary author: PARK, Hanseo (University of Tsukuba (JP))

Presenter: PARK, Hanseo (University of Tsukuba (JP))

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **197** Type: **Poster**

Model study of jet fragmentation transverse momentum distributions in pp collisions using D0-meson tagged jets.

Tuesday 25 April 2023 17:00 (20 minutes)

The fragmentation of partons is studied using the jet fragmentation transverse momentum, j_{T}. The j_{T} is defined as the perpendicular component of the momentum of the constituent particle with respect to reconstructed jet momentum, \vec{p}*{jet}. The jT provides a measurement of the transverse momentum spread of the jet fragments. Recently, the direct dead-cone effect was measured by ALICE in terms of the splitting angle of jet fragments by comparing the D0 meson-tagged jets and inclusive jets. The effect arises due to the conservation of angular momentum during the gluon emission and is significant for low-energy heavy-flavour quarks. In this model study, we explore the dead cone effect in a frame of j*{T} as j_{T} is a good tool to measure the spread of jet fragments for D0 meson tagged jets with respect to inclusive jets in momentum space.

Theory / experiment

Experiment

Group or collaboration name

Primary author: LEE, Hyungjun (Sungkyunkwan University (KR))

Presenter: LEE, Hyungjun (Sungkyunkwan University (KR))

Session Classification: Poster Session

Track Classification: Jets and medium response

Contribution ID: **198** Type: **Poster**

Dijet studies at the LHC

Tuesday 25 April 2023 17:20 (20 minutes)

High-energy partons generated in relativistic particle collisions create well-collimated showers of particles, which are called jets. The jet study is used widely in heavy-ion collisions, where the quark-gluon plasma (QGP) medium forms. Previous studies from RHIC and LHC indicate that dijet invariant mass can be sensitive to modifications caused by the QGP medium. In this study, we present a model study of the dijet mass distributions in proton-proton and proton-lead collisions at a center-of-mass energy of 5.02 TeV as preparation before measuring the dijet invariant mass in the data. I used the anti-kt algorithm for jet reconstruction with the resolution parameter R=0.4. In the result, the modifications of proton-lead collisions and proton-proton Monte Carlo simulation results are negligible but significant in the region of low dijet mass. The raw data should be corrected due to the inefficiencies of undetected missed and over-detected fake charged particles, the procedure called unfolding. In this study, I present the unfolded spectra of the proton-lead data, but lead-lead needs to be developed for the correction of lost jets due to background subtraction.

Theory / experiment

Experiment

Group or collaboration name

Primary authors: KIM, Beomkyu (Sungkyunkwan University); Mr BAE, Joonsuk (Sungkyunkwan University (KR))

Presenter: Mr BAE, Joonsuk (Sungkyunkwan University (KR))

Session Classification: Poster Session

Track Classification: Jets and medium response

Contribution ID: **199** Type: **Poster**

Investigation of the cause and establishment of a suppression method of Fake Hits generated in the readout circuit board of sPHENIX-INTT silicon detector

Tuesday 25 April 2023 17:40 (20 minutes)

In April of this year, the sPHENIX experiment began at Brookhaven National Laboratory (BNL) in the United States, measuring the properties of a quark-gluon plasma (QGP) state created by colliding gold atoms accelerated by the Relativistic Heavy Ion Collider (RHIC). The sPHENIX Japan group (Nara Women's University, Rikkyo University, and RIKEN) is responsible for developing and constructing the INTT detector, one of three tracking detectors to be implemented in sPHENIX. INTT is a detector that discriminates accurate hits with excellent time resolution and reconstructs particle trajectories. The INTT consists of 56 silicon ladders assembled and is an assembly of silicon ladders assembled into a two-layer barrel shape. When the ladder was used to collect and analyze the data, it was observed that hits observed "unphysical data"were contaminated in the data accumulated. The "unphysical data"differ species from so-called noise from their behavior. The noise is typically concentrated in the small ADC deposit region, while the ADC of the "unphysical data"seems arbitrary. Here, we call them Fake Hits. This study aims to investigate the cause of these Fake Hits and establish a method to suppress them.

Theory / experiment

Experiment

Group or collaboration name

sPHENIX

Primary author: Mr SHISHIKURA, Ryota (for the sPHENIX-INTT collaboration)

Presenter: Mr SHISHIKURA, Ryota (for the sPHENIX-INTT collaboration)

Session Classification: Poster Session

Track Classification: Electromagnetic probes

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

(1+1)-dimensional QCD at finite density with matrix product states

Wednesday 26 April 2023 15:05 (25 minutes)

We study the zero-temperature and finite-density phase of QCD in 1+1 dimensions on the basis of Hamiltonian lattice QCD and matrix product states. We variationally approximate the wave function of the ground state with nonzero chemical potential using the density matrix renormalization group and compute physical observables such as equation of state, chiral condensate, and quark distribution function, where conventional lattice QCD simulations suffer from the sign problem. Physical implication of our results is also discussed.

Theory / experiment

Theory

Group or collaboration name

Primary authors: HAYATA, Tomoya (Keio University); HIDAKA, Yoshimasa (KEK); Dr NISHIMURA, Kentaro (KEK)

Presenter: HAYATA, Tomoya (Keio University)

Session Classification: Parallel Session C

Track Classification: QCD phase diagram and extreme states

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

Fluctuations and correlations driven by the nuclear structure in relativistic heavy ion collisions

Monday 24 April 2023 16:15 (25 minutes)

Relativistic heavy ion collisions, especially the recent isobar ($^{96}_{44}$Ru+$^{96}_{44}$Ru and $^{96}_{40}$Zr+$^{96}_{40}$Zr) collisions, provide an opportunity to determine the structures of the colliding nuclei with good precision. Nuclear deformation, triaxiality, and sub-nucleon structure have recently been studied by $v_n - p_T$ correlations; size and shape differences between Ru and Zr have been extracted from the multiplicity and particle correlation differences between the two isobar collision systems. In this talk, I will present the effect of nucleon size, nuclear deformation, and nuclear shape fluctuations on the final state observable of multiparticle correlations and $v_n - p_T$ correlations in heavy ion collisions. I will also discuss the impact of bulk evolutions on the precision of nuclear structure determination. Our studies indicate that precise nuclear structure may be probed, unconventionally, by relativistic heavy ion collisions.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr XU, Haojie (Huzhou University)

Presenter: Dr XU, Haojie (Huzhou University)

Session Classification: Parallel Session A

Track Classification: Correlations and fluctuations

Contribution ID: **202** Type: **Poster**

Model study of charged particle production in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.36 TeV

Tuesday 25 April 2023 16:40 (20 minutes)

In this study, we present the model study of the charged-particle multiplicity density, dNch/dη in Pb-Pb collisions at a centre-of-mass energy per nucleon-nucleon pair of $\sqrt{s_{\mathrm{NN}}}$ = 5.36 TeV. The centre-of-mass energy for Pb-Pb collisions is the highest ever that is planned to be collected by LHC at the end of 2022 for the first time. The multiplicity of charged particles produced in the collisions is a key observable to characterise the properties of the matter created in these collisions, as the overall particle production is related to the initial energy density. Before the new frontier data collection, we prepared the model and theoretical calculations in different mechanisms for particle production in nuclear collisions. Model study of charged particle production in Pb–Pb collisions at the LHC with the ALICE detector.

Theory / experiment

Experiment

Group or collaboration name

Primary authors: KIM, Beomkyu (Sungkyunkwan University); PARK, Hyebin (Sungkyunkwan University (KR))

Presenter: PARK, Hyebin (Sungkyunkwan University (KR))

Session Classification: Poster Session

Track Classification: Initial state and thermal equilibrium

Contribution ID: **203** Type: **Poster**

Medium effects on two-particle correlations based on the theory of quantum open systems

Tuesday 25 April 2023 16:20 (20 minutes)

Hanbury Brown and Twiss (HBT) interferometry is used to investigate the shape and size of the matter produced in high-energy nuclear collisions. The Koonin-Pratt equation, which represents convolutions of the source function and the two-particle wave function in vacuum, has been used for the analysis. However, particles produced in a medium are affected during passing through it. In this talk, we extend the conventional framework of the HBT interferometry by considering the effect of medium. We employ the theory of open quantum system to represent a two-particle quantum system interacting with the environment. We obtain a master equation using a Hamiltonian that includes fluctuations caused by medium effects and investigate the time evolution of the density matrix. We find that the medium effect modifies the relative momentum dependence in the two-particle correlation function. This plays an important role in deducing the shape and size of the produced matter more precisely.

Theory / experiment

Theory

Group or collaboration name

Primary author: YAMAMOTO, Mamoru (Sophia University)

Co-authors: Dr AKAMATSU, Yukinao (Osaka University); HIRANO, Tetsufumi

Presenter: YAMAMOTO, Mamoru (Sophia University)

Session Classification: Poster Session

Track Classification: Correlations and fluctuations

Contribution ID: **204** Type: **Poster**

Simulation study of the Ring Imaging Cherenkov detector for the next-generation heavy-ion experiment at LHC

Tuesday 25 April 2023 17:00 (20 minutes)

ALICE3, the next-generation heavy-ion experiment, has been proposed for the LHC RUN 5 and 6 to investigate the Quark Gluon Plasma properties, exploiting precise measurements of heavy-flavour probes as well as electromagnetic radiation. These measurements require excellent particle identification (PID) capabilities in a wide transverse momentum range.
The development of a Ring Imaging Cherenkov detector using aerogel radiator and SiPM-based photo-detector is proposed for the charged PID in the ALICE 3 experiment.
A high PID performance is expected thanks to large photon detection efficiency and granularity of the sensor, even in high multiplicity Pb-Pb collisions.
The particle separation capability of e/π, and π/K/p can be achieved up to about 2 GeV/c and 10 GeV/c, respectively.
The detector specifications and performance, obtained by means of dedicated Monte Carlo simulation, will be presented. The design and R&D challenges will be also discussed.

Theory / experiment

Experiment

Group or collaboration name

the ALICE 3 RICH Collaboration

Primary author: KURITA, Shunsuke (for the ALICE 3 RICH Collaboration)

Presenter: KURITA, Shunsuke (for the ALICE 3 RICH Collaboration)

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **205** Type: **Poster**

Exploring high-density baryonic matter in J-PARC-HI Project

Tuesday 25 April 2023 16:20 (20 minutes)

J-PARC is one of the world's highest-intensity proton accelerators for material and life sciences, neutrino physics, and hadron and nuclear physics in the GeV energy region. We are planning to accelerate world's high-intensity heavy-ion beams at J-PARC. We will build a new compact heavy-ion linac and a booster ring as an injector, while we utilize the existing RCS and MR synchrotrons to accelerate up to 10ˆ{11} Hz heavy-ion beams at 1-12 AGeV/c. We will explore QCD phase structures in a high-baryon density regime such as the first-order phase boundary and the QCD critical point, and QCD superconducting phases. We also search for various multi-strangeness particles/nuclei and studying hadron interactions including strangeness. In this presentation, we will show the staging strategy of J-PARC-HI with the existing primary proton beam line and the J-PARC E16 spectrometer (Phase 1), and upgrade of the booster ring with the extension of the proton beam line and the construction of the new large acceptance spectrometer (Phase 2). We show the status of the dilepton measurements in p+A collisions at J-PARC E16, which has started since 2020. Then, we will show some of the physics feasibility for dilepton and hadron measurements with Phase 1 and Phase 2.

Theory / experiment

Experiment

Group or collaboration name

J-PARC-HI Collaboration

Primary author: SAKO, Hiroyuki (Japan Atomic Energy Agency)

Presenter: SAKO, Hiroyuki (Japan Atomic Energy Agency)

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **206** Type: **Oral**

Development of 3+1D glasma simulation in Milne coordinates and its application to the glasma evolution

Monday 24 April 2023 13:50 (25 minutes)

The real-time lattice simulation of the classical Yang-Mills (CYM) field is widely used to describe the non-equilibrium evolution of the highly-occupied and weakly coupled gluon matter, called glasma, in the early stage of the relativistic heavy-ion collision. When we study the glasma with the CYM simulation, we often assume no rapidity dependence, namely the boost invariance. This assumption means the relativistic limit and is effective, especially in studying experimental results in the central rapidity region. However, in recent years, much attention has been paid to the rapidity dependence of the glasma beyond the boost invariance [1-3].

In this study, we propose a new numerical simulation method for the 3+1D CYM simulation based on the MV model. We give the initial condition of the CYM field and two 3D classical color sources on a lattice when the two nuclei are still apart. We then solve the discretized classical equation of motion and obtain their evolution. The strategy given above is basically the same as that in [3] but is performed in Milne coordinates, whereas the previous 3+1D CYM simulation employs Minkowski coordinates. Since Milne coordinates automatically account for the expanding geometry in the collision, the lattice simulations in the Milne coordinates are expected to save the longitudinal volume of the lattice used in the simulation.

We apply the 3+1D CYM simulation to the central and non-central collisions. We show the energy density, pressure, and angular momentum and compare them with previous papers' results and experimental values.

1 B. Schenke and S. Schlichting, Phys. Rev. C 94, 044907 (2016).
[2] A. Ipp and David I. Müller, Eur. Phys. J. A 56, 9, 243 (2020).
[3] S. Schlichting and P. Singh, Phys. Rev. D 103, 1, 014003 (2021).

Theory / experiment

Theory

Group or collaboration name

Primary author: MATSUDA, Hidefumi

Co-author: Prof. HUANG, Xu-Guang

Presenter: MATSUDA, Hidefumi

Session Classification: Parallel Session B

Track Classification: Initial state and thermal equilibrium

Contribution ID: **207** Type: **Poster**

Computational Deep Neural Network for Solving Differential Equation

Tuesday 25 April 2023 18:00 (20 minutes)

Neuron, the basic unit of nerve cells, transmits stimuli by sending neurotransmitters to other neurons when receiving signals above the threshold. The algebraic structure that mimics this process is called perceptron, the basic unit of the artificial neural network (ANN). The ANN is used to solve problems in many fields of data processing such as classification, and is a useful tool, self-updating weights at each learning step, unlike traditional machine learning methods. In the past, the ANN has been used to solve linear classification problems only. However, currently, using algebraic processes that deal with inputs and outputs, the neural networks are now applied to solving the nonlinear classification and learning in many fields such as images, voice, and text. The property of the ANN is also being studied by many researchers in physics as a tool that can be used in numerical calculations. Physicists are interested in the change of nature in time, and therefore we need to solve the differential equations. Some of them are not solved analytically and they require numerical calculations. In this study, we discuss how to solve the differential equations numerically using the ANN. We also present a deep neural network model that can be applied to differential equations by adopting an improved activation function instead of those commonly used.

Theory / experiment

Theory

Group or collaboration name

Primary author: KIM, Hyunwoo (Inha University (KR))

Co-authors: Prof. KIM, Do Wan (Inha University); YOON, Jin Hee (Inha University (KR))

Presenter: KIM, Hyunwoo (Inha University (KR))

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

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

Probing jet transport coefficient of cold nuclear matter in electron-ion collisions

Wednesday 26 April 2023 14:40 (25 minutes)

We present a study of the nuclear-medium induced transverse momentum broadening of particle production in future electron-ion-collision (EIC) experiments. By considering the multiple scattering between hard partons and cold nuclear medium within the higher-twist factorization framework in perturbative QCD, we calculate the transverse momentum broadening of single hadron production in semi-inclusive measurements, as well as the nuclear enhancement of the transverse momentum imbalance for di-hadron and heavy-meson pair productions. In particular, a kinematics dependent non-perturbative jet transport coefficient $\hat{q} = \hat{q}(x, Q^2)$ extracted in a global analysis of the current data, together with its uncertainty determined with a Hessian method, are input into our calculations and are available for the community. Significant kinematic and color-state dependence of the nuclear induced broadening/imbalance are predicted. Our results indicate that the future EIC measurements are able to provide powerful constraints on the kinematic dependence of the transport coefficient $\hat{q}$ and thus greatly facilitate the jet tomography of cold nuclear medium.

Theory / experiment

Theory

Group or collaboration name

Primary authors: ZHANG, Ben-Wei (Central China Normal University); Prof. WANG, Enke (South China Normal University); Dr XING, Hongxi (South China Normal University); RU, Peng (South China Normal University); KANG, Zhongbo (UCLA)

Presenter: RU, Peng (South China Normal University)

Session Classification: Parallel Session A

Track Classification: Jets and medium response

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

Event-by-event fluctuations of mean transverse momentum in Pb-Pb and Xe-Xe collisions with ALICE

Monday 24 April 2023 16:40 (25 minutes)

Event-by-event fluctuations of mean transverse momentum, $\langle p_{\mathrm{T}} \rangle$, help to characterize the properties of the bulk of the system created in ultrarelativistic heavy-ion collisions, called the quark-gluon plasma (QGP). The fluctuations are closely related to the dynamics of the phase transition from the QGP to a hadron gas.
In this contribution, event-by-event fluctuations of $\langle p_{\mathrm{T}} \rangle$ of charged particles produced in Pb-Pb and Xe-Xe collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV and $\sqrt{s_{\mathrm{NN}}} = 5.44$ TeV, respectively, are studied as a function of the charged-particle multiplicity using the ALICE detector at the LHC. Non-statistical fluctuations are observed in both collision systems, which indicate correlated particle emission. The central collisions show a significant reduction of these fluctuations in comparison to peripheral collisions indicating a dilution scenario that cannot be explained just by superposition of partially independent particle-emitting sources. The results in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV are in qualitative agreement with previous measurements in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV. A comparison with the HIJING model is also discussed.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary author: TRIPATHY, Tulika (IIT- Indian Institute of Technology (IN))

Presenter: TRIPATHY, Tulika (IIT- Indian Institute of Technology (IN))

Session Classification: Parallel Session A

Track Classification: Correlations and fluctuations

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

Trace anomaly as a measure of conformality at finite density

Wednesday 26 April 2023 15:50 (25 minutes)

We shed a light on the nature of matter at extremely high baryon density and contrast it to hot QCD matter by using the trace anomaly as a measure of conformality. We discuss an interpretation that a peak in the sound velocity in high-density matter, as suggested by the neutron-star observational data, signifies strongly-correlated conformal matter. The normalized trace anomaly is a dimensionless measure of conformality leading to the derivative and the non-derivative contributions to the sound velocity. We find that the peak in the sound velocity is attributed to the derivative contribution from the trace anomaly that steeply approaches the conformal limit. Smooth continuity to the behavior of high-density QCD implies that the matter part of the trace anomaly may be positive definite. We discuss a possible implication of the positivity condition of the trace anomaly on the observable quantities in the real world.
Reference: Phys. Rev. Lett. 129, 252702 [2207.06753]

Theory / experiment

Theory

Group or collaboration name

Primary authors: FUJIMOTO, Yuki (University of Washington); Prof. FUKUSHIMA, Kenji (The University of Tokyo); MCLERRAN, Larry; PRASZALOWICZ, Michal (Jagiellonian University, Krakow)

Presenter: FUJIMOTO, Yuki (University of Washington)

Session Classification: Parallel Session C

Track Classification: QCD phase diagram and extreme states

Contribution ID: **211** Type: **Poster**

Evaluation of a high-speed transmission cable for sPHENIX-INTT silicon detector

Tuesday 25 April 2023 16:20 (20 minutes)

The sPHENIX experiment at Brookhaven National Laboratory (BNL) is a next-generation experiment equipped with a large solid angle detector to detect jets and precisely measure QGP properties. sPHENIX's INTT detector is a strip-type silicon detector that is positioned 7˜10 cm from the collision point. The signal transmission cable of the INTT detector requires the development of a conversion cable.
The first prototype of a conversion cable employing FPC technology was manufactured. However, during the testing process, it was found that the FPC cables were not flexible enough and that the signal attenuation exceeded the acceptable range. In order to overcome these problems, the micro coaxial cable (μ-coax) was employed as an alternative solution. It's diameter is 0.04 mm and a signal line width of 0.25 mm. While its mechanical and electric features satisfies the requirements, it is well known that the insulator material, i.e. PFA is susceptible against radiation. Therefore, this study evaluates the transmission performance of the fabricated μ-coax and the radiation resistance of the μ-coax when installed in the sPHENIX experiment.

The transmission performance is evaluated by three measurements; 1) s-parameter, 2) impedance (TDR), 3) eye-diagram measurements. Attempted data collection from silicon ladder using daisy-chained cables and μ-coax
To evaluate radiation resistance, we first estimated expected radiation dose at the location of conversion cables to be located during sPHENIX operation. As a result, we estimated the expected radiation dose around the region where cables are installed is 1.5×10ˆ11 Equivalent Neutrons. The RIKEN neutron irradiation system was used to irradiate μ-coax with higher than expected radiation dose. Neutron dosage was calculated using indium foil, which emits γ-rays proportionate to neutrons received. Transmission performance was re-evaluated after neutron irradiation to assess radiation effects and resistance.

Theory / experiment

Experiment

Group or collaboration name

sPHENIX

Primary author: KATO, TOMOYA (Rikkyo University(for the sPHENIX-INTT collaboration))

Presenter: KATO, TOMOYA (Rikkyo University(for the sPHENIX-INTT collaboration))

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **212** Type: **Poster**

An efficient implicit numerical solver for relativistic hydrodynamics

Tuesday 25 April 2023 17:40 (20 minutes)

Numerical hydrodynamics is an indispensable tool to describe the dynamics of relativistic heavy-ion reactions. Its stability is usually difficult to handle, especially in fluctuating hydrodynamics. We develop a stable implicit numerical method for solving relativistic hydrodynamics that can be more efficient than conventional explicit methods. Implicit methods are desirable considering their stability advantage compared to explicit ones. Nevertheless, they are generally considered to be computationally expensive. In this presentation, we solve this problem by introducing a fixed-point solver for the implicit Runge-Kutta methods with a new optimization through spatial stiffness detection. We implement the new implicit schemes as well as explicit ones and compare their accuracy and computational costs. We demonstrate the correctness and efficiency of the implicit methods in the case of ideal hydrodynamics by checking the convergence in the small time-step limit and comparing numerical results to the analytical solutions of the Riemann problem and the Gubser flow. The comparison is also performed in the context of heavy-ion collisions by using the TRENTo event-by-event initial conditions where viscosity is also considered. Contrary to the general expectation, we find that in these cases, the implicit scheme is more efficient for fixed accuracy than the conventional explicit methods.

Theory / experiment

Theory

Group or collaboration name

Primary author: TOUROUX, Nathan

Co-authors: PIHAN, Grégoire; MURASE, Koichi (Yukawa Institute for Theoretical Physics, Kyoto University); Dr BLUHM, Marcus (Subatech. Nantes); NAHRGANG, Marlene (Subatech); KITAZAWA, Masakiyo

Presenter: TOUROUX, Nathan

Session Classification: Poster Session

Track Classification: Collective dynamics

Contribution ID: **213** Type: **Oral**

Dynamical effects on the phase transition signal

Monday 24 April 2023 17:05 (25 minutes)

The QCD phase transition signals at RHIC are expected to be observed via the measurement of net-proton's high order cumulants 1. In this talk, we will present our recent study of dynamical effects on the high order cumulants of the QCD chiral field in a system with finite-size. We find much stronger memory effects on the first-order phase transition side than on the crossover side. Besides, the dynamical cumulants at the hypothetical freeze-out line present rich non-monotonic structures, which is suggestive to the explanation of the experimental data [2].
Further, within the same dynamical framework, we also study the dynamical behaviors of the newly developed first-order phase transition crirerion Δ [3]. Related factors such as the phase transition scenarios, the initial temperature, the volume size, the relaxation rate, as well as different evolution trajectories are discussed seperately [4].

1 J. Adamet al. (STAR Collaboration), Phys. Rev. Lett.126,092301 (2021).
[2] L. Jiang, H. St¨ocker and J. H. Zheng, Eur. Phys. J. C 83 (2023) no.2, 117.
[3] Y. Lu, F. Gao, X. Luo, L. Chang and Y. x. Liu, arXiv:2211.03401.
[4] L. Jiang, F. Gao, H. Song, and Y. x. Liu, in preparations.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr JIANG, Lijia (Northwest University)

Presenter: Dr JIANG, Lijia (Northwest University)

Session Classification: Parallel Session A

Track Classification: Correlations and fluctuations

Contribution ID: **214** Type: **Poster**

Effect of hydrodynamic fluctuations on mixed harmonic cumulants

Tuesday 25 April 2023 16:20 (20 minutes)

We analyze the effect of hydrodynamic fluctuations on normalized mixed harmonic cumulants (nMHC) based on a realistic dynamical model of the high-energy heavy-ion collisions for the first time.

The spacetime evolution of quark-gluon plasma (QGP) in high-energy heavy-ion collisions is described by hydrodynamics. The transport properties of QGP such as shear and bulk viscosity have been studied by comparing hydrodynamic calculations with flow observables of experimental data.
Recently, hydrodynamics fluctuations turned out to affect the flow coefficients and correlations and thus cannot be ignored for the precise determination of the QGP properties.

In this study, we investigate the effect of the hydrodynamic fluctuations on general flow correlations in detail using an integrated dynamical model, where we combine the TrENTo initial conditions, relativistic fluctuating hydrodynamic code (rfh), and UrQMD as an afterburner. We calculate nMHC, which are useful observables to differentiate models, to compare the models of hydrodynamics.We first show the effect of hydrodynamic fluctuations on nMHC. We also analyze the effect of hydrodynamic fluctuations with different viscosity temperature dependencies. We find that the effect of hydrodynamic fluctuations in a $nMHC(v_2^2, v_4^2)$ is similar to that of decreasing the shear viscosity. We argue the importance of considering hydrodynamic fluctuations in dynamical models for the determination of the QGP properties.

Theory / experiment

Theory

Group or collaboration name

Primary authors: SAKAI, Azumi; NONAKA, Chiho; OSHIMA, Kazuki; MURASE, Koichi (Yukawa Institute for Theoretical Physics, Kyoto University)

Presenter: NONAKA, Chiho

Session Classification: Poster Session

Track Classification: Correlations and fluctuations

Contribution ID: **215** Type: **Poster**

Verifying repulsive Λ potential at high densities using heavy-ion collision and hypernuclear data

Tuesday 25 April 2023 16:20 (20 minutes)

The hyperon puzzle, namely the problem that hyperonic matter equations of state cannot support the observed massive neutron stars, has been attracting much attention. One of the proposed scenarios is that the Λ particles do not appear even at high densities due to the repulsive Λ potential at high densities generated by the ΛNN three-body force between the Λ particles and medium nucleons. From the chiral effective field theory, a Λ potential that satisfies this scenario has been obtained (Gerstung et al. (2020)). However, the density dependence of this potential has not been verified using experimental data.

In this talk, we will report that the above Λ potential reproduces the experimental data of heavy-ion collisions and Λ hypernuclei. We have found that the repulsive Λ potential explains both data on the Λ directed flow of heavy-ion collisions at $\sqrt{s_{NN}} = 3.0 - 20$ GeV within a relativistic quantum molecular dynamics implemented in JAM (Nara et al. (2022)), and the Λ binding energy of hypernuclei by the spherical Skyrme-Hartree-Fock method (Jinno et al. in prep.) within the uncertainties of the model. We conclude that the repulsive Λ potential from the ΛNN three-body force can be a solution for the hyperon puzzle.

We also discuss the possibility that the Λ-potential parameter region allowed by the data of the Λ binding energy extends to a more repulsive region than empirical ones (Lanskoy, Yamamoto (1997); Gurelia et al. (2012)). If the time allows, we also examine the empirical Λ potential using heavy-ion data.

Theory / experiment

Theory

Group or collaboration name

Primary authors: JINNO, Asanosuke; MURASE, Koichi (Yukawa Institute for Theoretical Physics, Kyoto University); Prof. NARA, Yasushi (Akita International University); OHNISHI, Akira

Presenter: JINNO, Asanosuke

Session Classification: Poster Session

Track Classification: Hadron interactions and exotics

Contribution ID: **216** Type: **Oral**

Momentum-dependence of hydrodynamization in heavy-ion collisions

Monday 24 April 2023 13:50 (25 minutes)

The relativistic hydrodynamic model has been vital to the analysis of the QCD matter created in high-energy heavy-ion collisions. Experimental data indicate that low momentum particles are thermal and hydrodynamic, while high momentum particles are non-thermal and perturbative. We investigate two scenarios - (i) the Tsallis hydrodynamic model where an extended momentum range is treated as hydrodynamic 1, and (ii) the red hydrodynamic model where high momentum contributions are strictly excluded from the medium [2] - to elucidate the momentum-dependence of thermalization/hydrodynamization in heavy-ion collisions using numerical simulations.

1 K. Kyan, A. Monnai, Phys. Rev. D 106, 054004 (2022)

[2] A. Monnai, arXiv:2301.00588 [nucl-th]

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr MONNAI, Akihiko (Osaka Institute of Technology)

Presenter: Dr MONNAI, Akihiko (Osaka Institute of Technology)

Session Classification: Parallel Session A

Track Classification: Collective dynamics

Contribution ID: **217** Type: **Poster**

Impact of nuclear deformation on longitudinal flow decorrelations in high-energy isobar collisions

Tuesday 25 April 2023 17:00 (20 minutes)

Fluctuations of harmonic flow along pseudorapidity η, known as flow decorrelations, is an important probe of the initial condition and final state evolution of the quark-gluon plasma. We show that the flow decorrelations are sensitive to the deformations of the colliding nuclei. This sensitivity is revealed clearly by comparing flow decorrelations between collisions of isobars, ^{96}Zr+^{96}Zr and ^{96}Ru+^{96}Ru, which have different deformations. Longitudinal flow decorrelations in heavy-ion collisions is a new tool to probe the structure of colliding nuclei.

Theory / experiment

Theory

Group or collaboration name

Primary author: Dr NIE, Maowu (Shandong University (SDU))

Presenter: Dr NIE, Maowu (Shandong University (SDU))

Session Classification: Poster Session

Track Classification: Collective dynamics

Contribution ID: **218** Type: **Oral**

Probing the hadronic phase with resonance production in pp, p–Pb and Pb–Pb collisions with ALICE at LHC

Wednesday 26 April 2023 15:05 (25 minutes)

Hadronic resonances are effective tools for studying the hadronic phase in ultrarelativistic heavy-ion collisions. In fact, their lifetime is comparable to that of the hadronic phase, and resonances are sensitive to effects such as rescattering and regeneration processes, which might affect the resonance yields and shape of the transverse momentum spectra. These processes can be studied considering the yield ratio of resonance to the corresponding long-lived particle as a function of the charged-particle multiplicity. Measurements of hadronic resonances have been performed with the ALICE detector at the LHC in pp, p–Pb, and Pb–Pb collisions at different energies.

In this contribution, we report on new ALICE results on the production of resonances at LHC energies in pp, p–Pb, and Pb–Pb collisions. The transverse momentum (p_{T}) spectra, p_{T}-integrated yields, and ratios of p_{T}-integrated resonance yields to those of long-lived particles will be discussed as a function of multiplicity in all collision systems. Additionally, the experimental results obtained will be compared with the theoretical predictions.

Theory / experiment

Experiment

Group or collaboration name

ALICE

Primary authors: SONG, Jihye (Pusan National University); PADHAN, Sonali (IIT- Indian Institute of Technology (IN))

Presenter: SONG, Jihye (Pusan National University)

Session Classification: Parallel Session B

Track Classification: QGP in small systems

Contribution ID: **220** Type: **Poster**

Monte Carlo study of Schwinger model at finite density

Tuesday 25 April 2023 16:20 (20 minutes)

The Schwinger model (QED in one spatial dimension) is known as a toy model of QCD. We perform a Monte Carlo study of the Schwinger model at finite density. We circumvent the notorious sign problem by using the bosonization technique. We find that the number density is a smooth function of the chemical potential. This talk is based on arXiv:2303.05481 [hep-lat].

Theory / experiment

Theory

Group or collaboration name

Primary author: OHATA, Hiroki (YITP, Kyoto University)

Presenter: OHATA, Hiroki (YITP, Kyoto University)

Session Classification: Poster Session

Track Classification: QCD phase diagram and extreme states

Contribution ID: **221** Type: **Poster**

Numerical calculation of meson mass using two-body Dirac equation

Tuesday 25 April 2023 16:20 (20 minutes)

Quark-gluon plasma is a substance that scientists predict existed in the early universe according to Quantum Chromodynamics, and evidence for its existence is being discovered through both theory and experiment. Since QGP is in thermal equilibrium, researchers are studying its thermal properties to understand how it evolves over time. As the temperature rises, mesons separate into quarks and gluons at a certain temperature, and by observing the amount and types of mesons that survive at a given time, we can determine the temperature of the QGP. Meson masses are an observable quantity that vary with temperature and cease to exist above the dissociation temperature. To calculate meson mass, we solved a two-body Dirac equation with a temperature-dependent potential using an AdS/CFT potential with a 5-dimensional gravitational model that confirms confinement within a quark-antiquark system. Our calculations show that the relative errors for mesons with a mass greater than 3 GeV are less than 1%.

Theory / experiment

Theory

Group or collaboration name

Inha University

Primary authors: YOON, Jin Hee (Inha University (KR)); HONG, Younghoo (Inha University)

Presenter: HONG, Younghoo (Inha University)

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **222** Type: **Oral**

Effect of event-by-event fluctuations on light-nuclei yield ratio

Wednesday 26 April 2023 14:40 (25 minutes)

We investigate how the event-by-event fluctuations of the final-state distribution function of nucleons physically affect the yield ratio of light nuclei based on the coalescence model.

The yield ratio of light nuclei, $N_t N_p / N_d^2$ (with N_t, N_p, and N_d being triton, proton, and deuteron numbers, respectively) 1, is one of the observables suggested for a possible signal of the critical point of quantum chromodynamics (QCD). Based on the analyses with idealized setups, the yield ratio is known to be sensitive to the two-point neutron correlation and thus to the critical correlations. However, it is non-trivial how the yield ratio is affected by the other contributions in realistic setups of heavy-ion collisions, such as anisotropic flows [2] and the event-by-event fluctuations coming from the initial state.

In this talk, we establish a qualitative understanding of how event-by-event fluctuations affect the yield ratio. We model the "single-event" distribution $f(x, p)$ by a superposition of n-Gaussian hot spots in phase space and randomize the positions and magnitudes of the hot spots from event to event. We obtain analytical formulae for the yields of light nuclei and related ratios under this setup. We investigate how each feature of the event-by-event distribution affects the yield ratio. We find that the event-by-event fluctuations increase the yield ratio, where the value takes maximum at a particular hot-spot number n depending on the fireball size. The effective dimension of the fluctuations also affects the amount of increase. These understandings of the yield ratio will be important in analyzing the results of future realistic dynamical calculations.

1 K. J. Sun, L. W. Chen, C. M. Ko and Z. Xu, Phys. Lett. B **774** (2017), 103-107.
[2] S. Wu, K. Murase, S. Tang and H. Song, Phys. Rev. C **106** (2022), 034905.

Theory / experiment

Theory

Group or collaboration name

Primary authors: MURASE, Koichi (Yukawa Institute for Theoretical Physics, Kyoto University); WU, Shanjin (Lanzhou University, Peking University)

Presenter: MURASE, Koichi (Yukawa Institute for Theoretical Physics, Kyoto University)

Session Classification: Parallel Session C

Track Classification: QCD phase diagram and extreme states

Contribution ID: **223** Type: **Poster**

Charge-dependent anisotropic flow in relativistic resistive magneto-hydrodynamic expansion

Tuesday 25 April 2023 17:40 (20 minutes)

We have investigated the charge-dependent anisotropic flow in high-energy heavy-ion collisions, using relativistic resistive magneto-hydrodynamics (RRMHD).
First, we construct a relativistic resistive magneto-hydrodynamic (RRMHD) numerical simulation code for high-energy heavy-ion collisions. We confirm that our code reproduces well the results of standard RRMHD tests in the Cartesian coordinates and in the Milne coordinates.
Next, we apply our RRMHD code to analysis of the charge-dependent anisotropic flow in high-energy heavy-ion collisions. We consider the optical Glauber model as an initial model of the quark-gluon plasma (QGP) and the solution of the Maxwell equations with source term of the charged particles in two colliding nuclei as initial electromagnetic fields. The RRMHD simulation is performed with these initial conditions in Au-Au and Cu-Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. We have calculated the charge-odd contribution to the directed flow Δv_1 and elliptic flow Δv_2 in both collisions based on electric charge distributions as a consequence of RRMHD. We conclude that the charge-dependent anisotropic flow is a good probe to extract the electrical conductivity of the QGP medium in high-energy heavy-ion experiments.

Nakamura, Miyoshi, Nonaka and Takahashi, Phys.Rev.C 107 (2023) 1, 014901.
Nakamura, Miyoshi, Nonaka and Takahashi, 2211.02310 [nucl-th].
Nakamura, Miyoshi, Nonaka and Takahashi, 2212.02124 [nucl-th].

Theory / experiment

Theory

Group or collaboration name

Primary authors: NONAKA, Chiho; TAKAHASHI, Hiroyuki; NAKAMURA, Kouki; MIYOSHI, Takahiro (Hiroshima University (JP))

Presenter: NONAKA, Chiho

Session Classification: Poster Session

Track Classification: New theoretical developments

Contribution ID: **225** Type: **Poster**

Multiplicity dependence of Ξ_c^+ baryon production in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE

Tuesday 25 April 2023 16:20 (20 minutes)

Recent measurements of the baryon-to-meson production yield ratios between charm baryons (Λ_c^+, $\Sigma_c^{0,++}$, $\Xi_c^{0,+}$, Ω_c^0) and D mesons (D^0) in small collision systems show a significant enhancement with respect to the measurements performed in e^+e^- collisions. These results were compared with various models implementing a modified hadronization of charm quarks in hadronic collisions, which enhance the production of baryons.
The models can describe the measurements of Λ_c^+ and $\Sigma_c^{0,++}$, that don't contain the strange quark, but the description of $\Xi_c^{0,+}$ and Ω_c^0 measurements, which contain both charm and strange quarks, is still challenging.
Therefore further investigation is needed to unveil the hadronization of $\Xi_c^{0,+}$ and Ω_c^0.

The multiplicity dependence of Ξ_c^+ production will be studied, reconstructing the Ξ_c^+ via the hadronic decay channel $\Xi_c^+ \to \Xi^-\pi^+\pi^+$ at midrapidity in pp collisions at $\sqrt{s}$ = 13 TeV.

In this poster, the invariant-mass distributions of Ξ_c^+ in different multiplicity bins using minimum bias and high multiplicity triggered data recorded by the ALICE detector will be shown.
The yield extraction procedure, using a machine learning model based on Boosted Decision Tree algorithms, will be briefly introduced as well.
Furthermore, the strategy for the measurement of the Ξ_c^+ production cross section as a function of multiplicity will be discussed.

Theory / experiment

Experiment

Group or collaboration name

ALICE

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Co-author: KWEON, Min Jung (Inha University (KR))

Presenter: CHO, Jaeyoon (Inha University (KR))

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **226** Type: **Oral**

Forward quak dijet production in pA collisions in ITMD and CGC frameworks

Wednesday 26 April 2023 15:05 (25 minutes)

For studying small-x gluon saturation in forward dijet production in high-energy dilute-dense collisions, the improved TMD (ITMD) factorization formula was recently proposed, which contains the leading-twist TMD factorization formula relevant for small gluon's transverse momentum kt, but also incorporates an all-order resummation of kinematical twists, resulting in a proper matching to high-energy factorization at large kt.
In the Color Glass Condensate (CGC) framework, ITMD represents the approximation neglecting the genuine twist corrections. Here we evaluate the accuracy of the ITMD formula quantitatively, for the azimuthal angle correlations of quark dijet production in high-energy proton-proton (p+p) and proton-nucleus (p+A) collisions at LHC energies. For a dijet with each quark momentum pt much larger than the target saturation scale, Qs, the ITMD formula is a good approximation to the CGC formula in a wide range of azimuthal angle. It becomes less accurate as the jet pt 's are lowered, as expected, due to the presence of genuine higher-twist contributions in the CGC framework, which represent multi-body scattering effects absent in the ITMD formula. We will extend our discussion to the finite mass corrections for the case of heavy quark production.

Reference: H. Fujii, C. Marquet, K. Watanabe, JHEP12(2020)181

Theory / experiment

Theory

Group or collaboration name

Primary author: FUJII, Hirotsugu

Co-authors: MARQUET, Cyrille; WATANABE, Kazuhiro

Presenter: FUJII, Hirotsugu

Session Classification: Parallel Session A

Track Classification: Jets and medium response

Contribution ID: **229** Type: **Poster**

R&D activities of the FAZIA upgrade in Korea

Tuesday 25 April 2023 18:00 (20 minutes)

FAZIA (Forward A and Z Identification Array) is designed to identify charges and masses of reaction products from heavy-ion collisions from a few tens of MeV to about a hundred MeV per nucleon.
One basic unit of FAZIA consists of 4 x 4 shaped, three-layered telescopes.
The first and second layers are silicon sensors with different thicknesses of 300 um and 500 um, respectively, and one CsI scintillator detector read out by a photodiode follows at last.
The FAZIA detector identifies nuclei up to Z ˜ 52 in charges and Z ˜ 25 in masses and has been running successfully at GANIL since 2019.

The FAZIA upgrade project has started to cover a higher beam-energy range and increase the acceptance capability.
The Korean FAZIA team is working on the research and development of silicon sensors and the improvement of the front-end electronics board.
In particular, TCAD (Technology Computer Aided Design) simulation tool has been used to calculate the expected physical features of the silicon sensors, such as electric field and current density.
Based on the simulation result, our prototype of sensor designs was optimized and has been fabricated recently in collaboration with a domestic fab.

We will present the research and development activities conducted by the Korean FAZIA team in the upgrade project and show the fabricated sensor's measured properties, including the I-V curve and detector response respected to a radiation source.

Theory / experiment

Experiment

Group or collaboration name

FAZIA collaboration

Primary authors: KIM, Giyeong (Inha University (KR)); PARK, Jeonghyeok (Korea University (KR)); KIM, Jiyoung (Inha University (KR)); KWEON, Minjung (Inha University (KR)); HONG, Byungsik (Korea University (KR))

Presenters: KIM, Giyeong (Inha University (KR)); KIM, Jiyoung (Inha University (KR))

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **230** Type: **Poster**

Simulation studies and R&D status and plans in Japan for the EIC ePIC Barrel TOF with AC-LGAD

Tuesday 25 April 2023 16:20 (20 minutes)

EIC stands for Electron-Ion Collider, a circular accelerator to be constructed at BNL, which is expected to discover new physics, such as those related to gluon condensation, by colliding electrons and nuclei.
In Japan, the EIC Japan group has been established and is active.
The Japan group has decided to proceed with the development of barrel TOF and is planning to use AC-LGAD in its detector.
AC-LGAD is a silicon sensor with high position and time resolution, and it could fully meet the performance requirements of the detector described in the Yellow Report. This is being developed by BNL and KEK (in collaboration with HPK) for use at the HL-LHC.
Currently, while discussing the plan, AC-LGAD simulations are also being conducted. Specific progress is being made in studying the barrel TOF performance of the barrel and endcap in e-p collisions. The results show that a segment size of a few cm2 is sufficient for barrel TOF.
In addition, there are plans to build a new test bench in Japan. Hiroshima University is planning to install a new PMT, oscilloscopes, and other equipment to create an experimental environment.
This poster will present the results of these ongoing activities, specifically the Barrel TOF (AC-LGAD) simulations and the construction of the test bench.
Future plans include not only evaluating the performance of the detector (AC-LGAD) but also testing its radiation resistance.

Theory / experiment

Experiment

Group or collaboration name

the EIC Japan Group

Primary authors: MATSUTANI, Kanato (Hiroshima University); YAMAUCHI, Wataru (Hiroshima University)

Co-authors: AKIBA, Yasuyuki; GOTO, Yuji (RIKEN (JP)); HACHIYA, Takashi; Dr NAKAGAWA, itaru; SHIGAKI, Kenta (Hiroshima University (JP)); YANO, Satoshi (Hiroshima University (JP))

Presenters: MATSUTANI, Kanato (Hiroshima University); YAMAUCHI, Wataru (Hiroshima University)

Session Classification: Poster Session

Track Classification: Experimental techniques and future programs

Contribution ID: **231** Type: **Poster**

Higgs-confinement continuity in light of particle-vortex statistics

Tuesday 25 April 2023 16:20 (20 minutes)

It is widely believed that gauge theories with fundamental matters exhibit a smooth connection between the confining and Higgs regimes. This Higgs-confinement continuity is of crucial importance to the quark-hadron continuity conjecture, which claims a smooth crossover between the nuclear superfluidity and color superconducting phases in dense QCD. Certain gauge theories with superfluidity, such as dense QCD, have nontrivial Aharonov-Bohm (AB) phases around vortices, or anyonic particle-vortex statistics, in the Higgs regime. It is under debate whether this nontrivial AB phase implies a Higgs-confinement transition. In this talk, we address this question by providing evidence for the Higgs-confinement continuity. By explicit calculations in relevant lattice models, we demonstrate how the AB phase exhibits a smooth connection between the confining and Higgs regimes. We argue that (A) the AB phase takes a constant nontrivial value in both confining and Higgs regimes if some symmetry constrains the AB phase to discrete values and that (B) in the absence of such symmetry, the AB phase can smoothly interpolate the confining and Higgs limits. This finding sheds new light on topological nature of gauge-Higgs systems and suggests that the quark-hadron continuity remains a consistent scenario. This talk will be based on arXiv:2303.02129.

Theory / experiment

Theory

Group or collaboration name

Primary author: HAYASHI, Yui (YITP, Kyoto University)

Presenter: HAYASHI, Yui (YITP, Kyoto University)

Session Classification: Poster Session

Track Classification: New theoretical developments

Contribution ID: **232** Type: **Poster**

Gravitational form factors of a kink in 1+1 dimensional real scalar model

Tuesday 25 April 2023 18:00 (20 minutes)

Recently, experimental measurements of the energy-momentum tensor (EMT) distribution inside hadrons receive attentions their theoretical investigations are becoming increasingly important. In this presentation, focusing on localized structures in quantum field theory, we calculate the one-loop correction to the distribution of EMT around a kink in 1 + 1 dimensional ϕ^4 model and sine-Gordon model. We employ the collective coordinate method to eliminate the zero mode that gives rise to infrared divergence. The ultraviolet divergences are removed by vacuum subtraction and mass renormalization. We obtain an analytic result that is finite and satisfies the momentum conservation. The total energy of the kink obtained from the spatial integral of energy density reproduces the known result. Our EMT obtained on a finite space has a spatially-uniform term that is inversely proportional to the spatial length. We also calculate topological charge density and show that the spatial integral of 1-loop correction to topological charge density is zero.

Theory / experiment

Theory

Group or collaboration name

Primary author: ITO, Hiroaki (Osaka University)

Co-author: KITAZAWA, Masakiyo

Presenter: ITO, Hiroaki (Osaka University)

Session Classification: Poster Session

Track Classification: New theoretical developments

Contribution ID: **233** Type: **Poster**

Transport Model Approach to Quark-Gluon Plasma Equilibration

Tuesday 25 April 2023 18:00 (20 minutes)

The thermalization and chemical equilibration processes of the gluon dominated matter produced immediately after high energy collision are still poorly understood due to its far-from equilibrium nature. We use transport simulation to explore this phase where we include 2-to-3 interactions which are important to the thermal and chemical equilibration processes as the source of particle and entropy production. We prepare the initial condition for Au-Au at √s‘= 200 GeV in a far from equilibrium state with the mini-jet model inside a box with fixed length and periodic boundary condition. The transport model is based on hadronic transport model SMASH modified to be used with parton case Chemical equilibration is driven by quark-antiquark production/annihilation from gg → qqbar channel and gluon radiation/absorption process from gg → ggg, qg → qgg, and qq → qqg channels. Compared to previous models which often focused on exclusively gluon-only gluon absorption and radiation processes, here we added two new gluon absorption/radiation channels and analyze the effect of these two channels on the equilibration process. By using small fixed QCD coupling constant, we assume that perturbative QCD is still valid at relatively lower energy region and the energy spectrum of the ensemble in thermal equilibrium state approaches Boltzmann distribution function.

Theory / experiment

Theory

Group or collaboration name

Primary author: Mr ABDI, Cendikia (Hiroshima University)

Co-author: NONAKA, Chiho

Presenter: Mr ABDI, Cendikia (Hiroshima University)

Session Classification: Poster Session

Track Classification: Initial state and thermal equilibrium

Contribution ID: **234** Type: **Oral**

Measurement of sequential suppression of the excited-state bottomonia and observation of Y(3S) in PbPb collisions at $\sqrt{s_{NN}}$=5.02 TeV in CMS

Wednesday 26 April 2023 16:15 (25 minutes)

The information on the quarkonium production in heavy ion collisions is important to probe the heavy-quark dynamic in the quark-gluon plasma (QGP). The suppression of quarkonia production is particularly interesting since it comprises different in-medium effects such as color screening or recombination. But due to the inclusiveness of the nuclear modification factor used to quantify the suppression, it is important to have an improved resolution of the experimental data to distinguish the effects across the phase space. In this presentation, we provide the latest result of the excited Upsilon states measurement in heavy-ion collisions obtained by the CMS Collaboration. The experimental data provide a precision measurement of the nuclear modification factors of bottomonia in PbPb collisions with respect to pp collisions, and the ratio of the Y(3S) over Y(2S) states. The results are compared with the theoretical predictions, which may provide strong constraints to our current knowledge of the QGP model.

Theory / experiment

Experiment

Group or collaboration name

CMS Collaboration

Primary author: LEE, Soohwan (Korea University (KR))

Presenter: LEE, Soohwan (Korea University (KR))

Session Classification: Parallel Session A

Track Classification: Heavy quarks and quarkonia

Contribution ID: **235** Type: **Poster**

Muon triggering and reconstruction strategy for Run3 heavy ion collisions for CMS

Tuesday 25 April 2023 18:00 (20 minutes)

The upgrades for Run 3 of the CMS experiment at LHC improves both hardware and software, resulting in the enhancement of detection efficiency and data streaming capabilities for the accumulation of the physics data. In this poster, we will introduce the latest strategy of the muon trigger for the Run3 heavy-ion experiment. It employs the newly developed algorithms to increase the trigger performance in timing and the event trigger rate. We will also discuss the latest update about the method to derive the detection efficiency, the so-called tag-and-probe method, of muon.

Theory / experiment

Experiment

Group or collaboration name

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Presenter: LEE, Junseok (Korea University (KR))

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **236** Type: **Poster**

Separation of heavy-flavour decay muons with the ALICE Muon Forward Tracker (MFT)

Tuesday 25 April 2023 18:00 (20 minutes)

Heavy quarks, produced in hard-scattering processes in the very early stage of heavy-ion collisions, are efficient probes of the quark-gluon plasma (QGP) properties through its full evolution. They subsequently decay into particles such as muons and electrons. In ALICE, at LHC energies, muons are detected by the forward muon spectrometer and the Muon Forward Tracker (MFT). Full simulations have been performed to analyze particles produced in the forward rapidity region -3.6 < η < -2.5 with p > 4 GeV/c in pp collisions and Pb-Pb collisions. The beauty contribution (from B mesons) to the muon yield needs to be separated from the charm (from D mesons) component for in-depth studies of the properties of QGP. In this poster, the comparison of various quantities such as the distance of closest approach (DCA) and the transverse momentum (p T) distributions of decay muons from B mesons, D mesons, kaons, and pions are presented.

Theory / experiment

Experiment

Group or collaboration name

ALICE Collaboration

Primary author: ISHAK, Muhamad Noor Izwan (Hiroshima University (JP))

Presenter: ISHAK, Muhamad Noor Izwan (Hiroshima University (JP))

Session Classification: Poster Session

Track Classification: Hadron interactions and exotics

Contribution ID: **237** Type: **Poster**

Investigation of azimuthal anisotropy of charmonium with the CMS experiment

Tuesday 25 April 2023 18:00 (20 minutes)

The quark-gluon plasma(QGP) is considered the state of the early universe. The azimuthal anisotropy for charmonium states has been researched as one of the probes to understand the nature of the QGP. In this presentation, we will report recent progress regarding the study of the elliptic and triangular flow for prompt and nonprompt J/ψ and prompt ψ(2S) states in lead-lead collisions at the center-mass-energy per nucleon $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV with the CMS detector in 2018.

Theory / experiment

Experiment

Group or collaboration name

CMS

Primary author: KIM, Hyunchul (Chonnam National University (KR))

Presenter: KIM, Hyunchul (Chonnam National University (KR))

Session Classification: Poster Session

Track Classification: Heavy quarks and quarkonia

Contribution ID: **240** Type: **Poster**

Hyperon reconstruction methods with high purity and efficiency in Pb-Pb collisions at ALICE

Tuesday 25 April 2023 18:00 (20 minutes)

The precise knowledge of hyperon-hyperon interaction is one of the key measurements in QCD. To achieve this goal, it is fundamental to identify hyperons with a high purity in a high charged-particle multiplicity environment, such as a central Pb-Pb collisions. Thanks to its excellent particle identification and tracking performance, the ALICE experiment at the LHC is ideal for these measurements.
In this contribution, the performance of hyperon reconstruction in LHC run 2 (2015-2018) with ALICE will be shown. Additionally, new developments on secondary vertex reconstruction using the Kalman filter approach and Boosted Decision Tree will be shown. These developments are of fundamental importance for the high-luminosity Pb-Pb data-taking campaign foreseen at the end of 2023.

Theory / experiment

Experiment

Group or collaboration name

ALICE experiment

Primary author: TOKUMOTO, Ryoka (Hiroshima University (JP))

Presenter: TOKUMOTO, Ryoka (Hiroshima University (JP))

Session Classification: Poster Session

Track Classification: Hadron interactions and exotics

Contribution ID: **241** Type: **Poster**

Detectability of ω meson mass modification with pole dropping and/or broadening scenarios

Tuesday 25 April 2023 18:00 (20 minutes)

The origin of hadron masses cannot be attributed to the Higgs mechanism alone. On top of that, spontaneous breaking of chiral symmetry, potentially restored at extremely high temperatures, should play an important role. Light vector mesons (ρ, ω, φ) are highly sensitive to chiral symmetry restoration, so that a modification in their mass is expected. This study evaluates the detectability of ω meson mass modification. A dimuon spectrum from pp collisions at $\sqrt{s}$ = 13 TeV collected during Run 2 at ALICE is used for determining the input parameters. There are two mass modification scenarios: mass dropping, consisting in a shift to lighter states, and mass broadening, which has effects on the width of the bound state. In addition to these, a mass "dropping and broadening"scenario is also considered. This feasibility study is focused on the mass modification analysis for light vector mesons exploiting Pb-Pb collisions that will be collected next November during the Run 3 LHC campaign.

Theory / experiment

Experiment

Group or collaboration name

ALICE collaboration

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Thermodynamic properties of QGP formation with one loop correction at finite chemical potential

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Presenter: Prof. SOMORENDRO SINGH, Shougaijam

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