中国高能核物理网络论坛 (High Energy Nuclear Physics in China, HENPIC)

Report of Contributions

https://indico.ihep.ac.cn/e/11115

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

Previous seminars files information

One can also download the previous talk and video files at :
https://pan.baidu.com/s/1ofbOwrBQFde0K0ihOYZ8Sg
access code: p385

Those talks very earlier can also be found at : http://conf.ccnu.edu.cn/~henpic/
Or you can download their copy at:
https://pan.baidu.com/s/1KDPSLBjYd7kmOqKjYndzQg
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Contribution ID: **7** Type: **not specified**

The 86th HENPIC seminar by Jie Zhao (赵杰), Purdue University, Dec. 12-2019, Thursday 10:30 am (Beijing time)

Title: Search for the chiral magnetic effect in relativistic heavy-ion collisions

Speaker: Jie Zhao (赵杰), Purdue University Date: Thursday, Dec. 12, 10:30 am (Beijing time)
Download: https://pan.baidu.com/s/1KDPSLBjYd7kmOqKjYndzQg access code: vmgj

Abstract: Metastable domains of fluctuating topological charges can change the chirality of quarks and induce local P and CP violations in quantum chromodynamics (QCD). This can lead to observable charge separation along the direction of the strong magnetic field produced in relativistic heavy-ion collisions, a phenomenon called the chiral magnetic effect (CME). An observation of the CME-induced charge separation would confirm several fundamental properties of QCD, namely, restoration of the approximate chiral symmetry, non-trivial topological structures of the QCD vacuum, and local P and CP violations. It may also explain the magnitude of the matter-antimatter asymmetry in the present universe. I will discuss the current status of the experimental search for the CME, especially the recent progresses in the understanding of the background issues, and new ideas to search for the CME free of background contaminations.

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

The 87th HENPIC seminar by Feng Li (李峰), Lanzhou University (兰州大学), Dec. 24-2019, Thursday, 10:30am (Beijing time)

Title: Linear response theory and its application in the heavy-ion collisions

Abstract:

The linear response theory describe the system reaction against an external perturbation which drives the system away from the equilibrium, and is therefore widely used for studying the relaxation or the instability of a system near equilibrium. I will give an introduction on the application of the linear response theory in the heavy-ion collisions, especially on how to analyze the spinodal unstable modes of an extensive quark matter in the presence of a constant magnetic field.

个人简介：李峰，兰州大学青年研究员。2008 年于上海交通大学获得物理学学士学位，2016 年于 Texas A&M Univ. 获得理论核物理方向博士学位。2016-2018 年赴 Frankfurt Institute for Advanced Studies(FIAS) 从事博士后研究工作。2019 年 6 月以青年研究员身份加入兰州大学。目前的研究兴趣主要集中在大重子数夸克物质转向强子物质的相变、亚阈值重离子碰撞中奇异粒子的产额以及带自旋夸克的反常运动。

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

The 88th HENPIC seminar by Dr. Qipeng Hu (胡启鹏), University of Colorado Boulder, US (美国科罗拉多大学博尔德分校)，Jan. 16-2020, Thursday, 10:30am (Beijing time)

Title: Recent heavy-flavor results from ATLAS

Speaker: Dr. Qipeng Hu (胡启鹏), University of Colorado Boulder, US (美国科罗拉多大学博尔德分校)

Date: Thursday, Jan. 16, 2020, 10:30 am (Beijing time)

Abstract:

In A+A collisions, heavy-flavor (charm and bottom) quarks are created at the initial stage of the collision and experience the entire QGP evolution. Dissociation and regeneration of bound quarkonium states are sensitive to the effects of color screening and color recombination, while open heavy-flavor serves as penetrating probes energy loss mechanism and transport properties of heavy quarks in the QGP. In this seminar, selected results on the production and azimuthal anisotropy of the muons from open heavy-flavor hadron decays and bottomonium nuclear modification factor in different collision systems with the ATLAS experiments will be shown. The implications for our understanding of the QGP properties by comparing the results with model calculations will be discussed.

个人简介：
胡启鹏，科罗拉多大学博尔德分校博士后。2011 年于中国科学技术大学获得核工程与核技术学士学位，2017 年于中国科学技术大学获得粒子物理博士学位。2017 开始在科罗拉多大学博尔德分校从事博士后研究工作至今。目前研究方向为基于 ATLAS 重离子碰撞实验数据小系统集体流，高能光子和重味物理分析。

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

The 89th HENPIC seminar by Dr. Xiaojun Yao (姚晓骏), MIT, US (麻省理工学院)，Feb.6., 2020, Thursday, 10:30am (Beijing time)

Title: From Open Quantum System to Quarkonium Transport inside Quark-Gluon Plasma

Abstract:

The production of heavy quarkonium in heavy ion collisions has been used as an important probe of the quark-gluon plasma. Transport equations that take into account static plasma screening effect, dissociation and recombination have achieved great success in phenomenology. In this talk, I will explain why transport equations work well to describe the quarkonium evolution inside the quark-gluon plasma. I will start with the recent development in applying the open quantum system formalism to study quarkonium in-medium dynamics and show how to derive the transport equation in this formalism by using effective field theory. Weak coupling and Markovian approximations used in the derivation will be justified from a separation of scales. Finally, I will show some phenomenological results on Upsilon based on coupled transport equations of open heavy flavors and quarkonia.

个人简介：
姚晓骏，麻省理工学院博士后。2013 年在山东大学获得物理学士学位，2019 年在杜克大学获得物理博士学位。从 2019 年开始在麻省理工学院做博士后至今。主要研究有效场论和非平衡态物理在重离子碰撞中的应用。

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

The 90th HENPIC seminar by Prof. Yi Yin (尹伊), Institute of Modern Physics, CAS (中科院近代物理所), Feb.13, 2020, Thursday, 10:30am (Beijing time)

Title: Pre-hydrodynamics and pre-hydrodynamic response

Abstract:

We propose a new scenario characterizing the transition of the quark-gluon plasma (QGP) produced inheavy-ion collisions from a highly non-equilibrium state at early times toward a fluid described by hydrodynamics at late times. In this scenario, the bulk evolution is governed by a set of slow degree of freedom (d.o.f.), after an emergent time scale ⊠Redu , when the number of modes that govern the bulk evolution of the system is reduced. These slow d.o.f are "pre-hydrodynamic" in the sense that they are initially distinctfrom, but evolve continuously into, hydrodynamic d.o.f in hydrodynamic limit.This picture is analogous to the evolution of a quantum mechanical system thatis governed by the instantaneous ground states under adiabatic evolution, andwill be referred to as "adiabatic hydrodynamization". We shall illustrate adiabatic hydrodynamization using a kinetic description of weakly-coupled Bjorken expanding plasma. We first show the emergence of ⊠Redu due to the longitudinal expansion. We explicitly identify the pre-hydrodynamic d.o.f. for a class of collision integrals and find that they represent the angular distribution (in momentumspace) of those gluons that carry most of the energy. We use the relaxationtime approximation for the collision integral to show quantitatively that thefull kinetic theory evolution is indeed dominated by pre-hydrodynamic d.o.f..We elaborate on the criterion for the dominance of pre-hydrodynamic modes andargue that the rapidly-expanding QGP could meet this criterion. Based on thisdiscussion, we speculate that adiabatic hydrodynamization may describe thepre-equilibrium behavior of the QGP produced in heavy-ion collisions. Finally,we will discuss the excitations during "adiabatic hydrodynamization"stage by considering the medium' s response to an energetic moving parton. A preliminary study suggests that some of thoseexcitations are similarly to but distinguishable from sound waves.

个人简介：https://inspirehep.net/search?p=exactauthor%3AYi.Yin.1&sf=earliestdate

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

The 91st HENPIC seminar by Prof. Jian Zhou (周剑), Shandong Univ. (山东大学)，Feb.17, 2020, Monday, 10:30am (Beijing time)

Title: Probing the linear polarization of coherent photons in heavy ion collisions

Abstract:

We propose to measure the linear polarization of the external electromagnetic fields of a relativistic heavy ion through azimuthal asymmetries in dilepton production. I will also show that the linearly polarized photons can be used as a powerful probe to study QCD phenomenology in UPCs.

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

The 92nd HENPIC seminar by Dr. Shuai Liu (刘帅), Institute of Modern Physics, CAS (中国科学院近代物理所)，Feb.20, 2020, Thursday, 10:30am (Beijing time)

Title: Spin polarizations in a covariant angular momentum conserved chiral transport model

Abstract:
Using a covariant and total angular momentum conserved chiral transport model, which takes into account the spin-orbit interactions of chiral fermions in their scatterings via the anomalous side jump effect, we study the quark spin polarizations in quark matter. For a system of rotating and unpolarized massless quarks in an expanding box, we find that the side jump effect can dynamically polarize the quark spin with the final quark spin polarization consistent with that of thermally equilibrated massless quarks in a self-consistent vorticity field. For the quark matter produced in non-central relativistic heavy ion collisions, we find that both the quark local spin polarizations in the direction perpendicular to the reaction plane and along the longitudinal beam direction show an azimuthal angle dependence in the transverse plane similar to those observed in experiments for Lambda hyperons.

个人简介：刘帅，中科院近代物理研究所博士后。2012-2019 年在德州农工大学从事博士和博士后研究。2019 年秋至今在近代物理所从事博士后研究。博士及博士后期间主要研究强关联系统中的非微扰方法，多体物理和非平衡系统中的量子场论，以及它们在重离子碰撞中的应用。最近主要研究关于手征反常的理论和输运模型。

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

The 93rd HENPIC seminar by Prof. Nihar Ranjan Sahoo, Shandong University (山东大学)，Feb.27, 2020, Thursday, 10:30am (Beijing time)

Title: Direct photon+jet and h+jet measurement: STAR heavy-ion physics to future forward upgrade

Abstract:
The hot-dense QCD medium, popularly known as Quark-Gluon Plasma (QGP), is believed to be formed in the relativistic heavy-ion collider experiments. A high energetic parton traversing through this state of matter loses energy by radiating gluons due to its high virtuality, and then fragments into colorless hadrons; this phenomenon is coined as jet-quenching that was first observed at RHIC and later confirmed at the LHC. In this talk, I will discuss the recent RHIC results on direct-photon+jet and hadron+jet to study the in-medium parton energy loss, and also new emerging topics in this direction. I also plan to shed light on the new techniques developed for the jet measurement in heavy-ion collisions and its further application in the future jet measurement at RHIC experiments.

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

The 94th HENPIC seminar by Prof. Min He(何敏), Nanjing University of Science and Technology (南京理工大学)，March 5, 2020, Thursday, 10:30am (Beijing time)

Title: Charm-hadron production in pp and AA collisions

Abstract:
The enhancements of D_s/Dˆ0 and Lambda_c/Dˆ0 ratios in heavy-ioncollisions as recently measured at RHIC and the LHC have posedchallenges for theoretical models. We address these puzzles bydeveloping a theoretically controlled hadronization framework of heavyquarks that conserves 4-momentum and recovers thermal and chemicalequilibrium limits. In particular, we implement space-momentumcorrelations of charm quarks with flowing partons as a genuineconsequence of a hydrodynamic background, and an improved charmhadro-chemistry that incorporates additional charm hadrons beyond thecurrent listings by the PDG but predicted by the relativistic quarkmodel and lattice QCD. We show that the charm-hadron data at RHIC andthe LHC can be fairly well accounted for by our strong-couplingframework of heavy-flavor transport and hadronization, within currenttheoretical uncertainties.

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

The 95th HENPIC seminar by Prof. Bowen Xiao(肖博文), Central China Normal University (华中师范大学), March 12, 2020, Thursday, 10:30am (Beijing time)

Title: The Collectivity of Heavy Mesons in pA collisions

Abstract:
Employing a model based on the Color Glass Condensate framework, we systematically study the azimuthal angular correlations between a heavy flavor meson and a light reference particle in proton-nucleus collisions. The obtained second harmonic coefficients (also known as the elliptic flows) for J/psi and D (including the prompt and non-prompt D) agree with recent experimental data from the LHC. We also provide predictions for the elliptic flows of the Upsilon and B meson, which can be measured in the near future at the LHC. This work can shed light on the physics origin of the collectivity phenomenon in the collisions of small systems.

This talk is based on 10.1103/PhysRevLett.122.172302 (arXiv:1901.10320) and arXiv:2002.09878 in collaboration with Cheng Zhang, Cyrille Marquet, Guang-You Qin, Yu Shi, Lei Wang and Shu-Yi Wei.

报告视频：https://bluejeans.com/s/BN2N4/

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

The 96th HENPIC seminar by Prof. Hengne Li(李衡讷), South China Normal University (华南师范大学), March 19, 2020, Thursday, 13:00 pm (Beijing time)

Title: Strong physics at LHCb: probing nuclear matter effects in small systems

Abstract:
The Standard Model of particle physics has demonstrated its predictive power in the electroweak and Higgs sectors, through the long-anticipated discovery of the Higgs boson and the per-mille-level agreement between direct and indirect determinations of the W-boson mass. However, due to the nonperturbative nature of QCD at low energy scales, the predictive power of the SM in the strong sector is more limited. Two examples of outstanding questions are the nature of the numerous recently discovered XYZ bound states and the mysterious nuclear matter effects of confined nucleons in nucleus and plasma-like quark matter in hot and dense conditions.The LHCb detector has unique capabilities at the LHC, being the only dedicated forward detector. While designed for high-precision measurements in the heavy flavour sector, its capabilities can also be applied to strong interaction physics. In this seminar, we will present some recent LHCb results in this area, probing cold nuclear matter effects and helping understand the nature of the X(3872) resonance.

Presenter: Prof. LI, Hengne (South China Normal University)

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

The 84th HENPIC seminar by Kai-jia Sun(孙开佳), Texas A&M University, Aug. 22, 2019, Thursday, 10:30 am (Beijing time)

Title: Light nuclei production as a probe of QCD phase diagram

Abstract:

Fluctuation signals of phase transitions from quark-gluon plasma (QGP) to hadronic matter can greatly advance our knowledge

of the nature of strong interaction. In relativistic heavy-ion collisions, the enhanced density fluctuations due to phase transitions (either first-order or second-order at CEP)

can cause large correlations in nucleon densities at final state, which in turn affect the productions of composite particles like light nuclei.

The light nuclei (e.g. deuteron) can only be formed within a restricted volume in phase space, therefore, they can probe local density fluctuation.

In this talk, I will demonstrate the usefulness and advantage of probing the QCD phase diagram with light nuclei produced in relativistic heavy-ion collisions.

In addition, I will discuss the recent experimental results at SPS and RHIC energies.

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

The 85th HENPIC seminar by Dr. Guan-nan Xie (谢冠男), Lawrence Berkeley National Lab, Sept. 19, Thursday 10:30 am (Beijing time)

Title: Measurement of Open Heavy Flavor Production in Au+Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV in STAR

Abstract:

Due to the large mass, heavy quarks are suggested to be an important tool for studying the properties of the Quark Gluon Plasma (QGP) produced in heavy-ion collisions. In this presentation, we will report on the measurements of production of various charmed hadrons ($D^0(\overline{D^0})$, $D_s^{\pm}$, $D^{*\pm}$, $D^{\pm}$ and $\Lambda_c^{\pm}$) as well as open bottom production through displaced decay daughters in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV, utilizing the Heavy Flavor Tracker at STAR. Precise results on the D^0 yields are reported for a wide transverse momentum range down to 0 GeV/c in various centrality bins. We will also report on the $D^{\pm}$, $D^{*\pm}$, $D_s^{\pm}$ and $\Lambda_c^{\pm}$ spectra measured in different collision centralities and the total charm quark cross section extracted from these measurements in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. In addition, we will present the nuclear modification factors for daughters from decays of bottom hadrons and compare them to those for charm hadrons.

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

The 97th HENPIC seminar by Prof. Haojie Xu (徐浩洁), Huzhou University (湖州师范学院)，March 26, 2020, Thursday, 10:30am (Beijing time)

Title: Importance of non-flow background on the chiral magnetic wave search

Abstract:
An observable sensitive to the chiral magnetic wave (CMW) is the charge asymmetry dependence of the π− and π+ anisotropic flow difference, Δvn(Ach). We show that, due to non-flow correlations, the flow measurements by the Q-cumulant method using all charged particles as reference introduce a trivial linear term to Δvn(Ach). The trivial slope contribution to the triangle flow difference Δv3(Ach) can be negative if the non-flow is dominated by back-to-back pairs. This can explain the observed negative Δv3(Ach) slope in the preliminary STAR data. We further find that the non-flow correlations give rise to additional backgrounds to the slope of Δv2(Ach) from the competition among different pion sources and from the larger multiplicity dilution to π+ (π−) at positive (negative) Ach.

Presenter: Dr XU, Haojie (Huzhou University)

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

The 98th HENPIC seminar by Dr. Zaochen Ye (叶早晨), Rice University (美国莱斯大学)，April 2nd, 2020, Thursday, 10:30am (Beijing time)

Title: Quarkonium Measurements in p+p, p+Au and Au+Au Collisions at 200 GeV with the STAR Experiment

Abstract:
Measurements of quarkonium production are an important tool to study the properties of the Quark-Gluon Plasma (QGP) formed in relativistic heavy-ion collisions. Quarkonium suppression due to the color-screening effect was proposed as a direct evidence of the QGP formation.However, other effects, such as cold nuclear matter effects and re generation, add additional complications to the interpretation of the observed suppression.Different quarkonium states with different binding energies are expected to dissociate at different temperatures, and therefore measurement of this "sequential melting" can help constrain the temperature of the medium. In this seminar, I will present and discuss the latest measurements of quarkonium (J/psi andUpsilon) production in p+p, p+Au and Au+Au collisions at 200 GeV with the STAR experiment.

报告人简介：叶早晨，2006 年-2010 年，兰州大学本科；2010 年-2012 年，兰州大学硕士研究生；2012 年-2018 年，伊利诺伊大学芝加哥分校博士。2018 年底加入莱斯大学从事博士后研究工作，目前的主要研究兴趣是极端相对论重离子碰撞中双轻子的产生。

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

The 99th HENPIC seminar by Dr. Dmytro Oliinychenko, Lawrence Berkeley National Lab (LBNL)， April 9th, 2020, Thursday, 10:30am (Beijing time)

Title: Light nuclei production in ultrarelativistic heavy-ion collisions

Abstract:
Recent measurements of deuteron, triton, hypertriton and helium nuclei in ultrarelativistic heavy ion collisions have become so precise, that the established models – coalescence and thermal – are also seeking to improve their precision. I present an alternative theoretical approach, where deuteron and triton are created and destroyed in the explicit pion and nucleon catalysis reactions. These reactions are built into the traditional transport approach, used to simulate heavy ion collisions. With calculations in this model I report current progress on understanding the connection between light nuclei production and the critical point of strongly-interacting matter.

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

The 100th : Symposium on high-energy nuclear physics –A special 100th session of High-energy Nuclear Physics in China (HENPIC) e-Forum, April 16th, 2020， Thursday 9:00am (Beijing time).

9:00-9:15 Welcome Address (Xin-Nian Wang and Speical Guests)

Session Chair: Xiaofeng Luo (CCNU)

9:15-9:45 Zhangbu Xu (BNL): Study of QGP at RHIC

9:45-10:15 Xiaoming Zhang (CCNU): Study of QGP at LHC

Break : 10:15-10:30

Session Chair: Qun Wang (USTC)

10:30-11:00 Elke-Caroline Aschenauern(BNL): Overview of EIC Physics

11:00-11:30 Xuguang Huang (Fudan University): Chirality, Magnetic Fields and Spin Polarization

11:30-12:00 Guangyou Qin (CCNU): Study of QGP through jet quenching

Talk abstracts :

1. Zhangbu Xu (BNL) : Study of QGP at RHIC

In this talk, I will review the major events and discoveries in the twenty years of RHIC operations and QGP studies.

2. Xiaoming Zhang (CCNU) : Study of QGP at LHC

The aim of the heavy-ion program at the LHC is to investigate the properties of the strongly-interacting matter, the quark-gluon plasma (QGP), formed in extreme conditions of temperature and energy density.
In this talk, after a brief illustration of the experimental program, an overview will be given to recent highlights on signatures and observables for exploring the QGP matter.

3. Elke-Caroline Aschenauern (BNL) : Overview of EIC Physics

Understanding the properties of nuclear matter and its emergence through the underlying partonic structure and dynamics of quarks and gluons requires a new experimental facility in hadronic physics known as the Electron-Ion Collider (EIC). The EIC will address some of the most profound questions concerning the emergence of nuclear properties by precisely imaging gluons and quarks inside protons and nuclei such as the distribution of gluons and quarks in space and momentum, their role in building the nucleon spin and the properties of gluons in nuclei at high energies. In January 2020 EIC received CD-0 and Brookhaven National Laboratory was chosen as site. This presentation will highlight the capabilities of an EIC and discuss its status, accelerator design and the concepts for the experimental equipment.

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4. Xu-guang Huang (Fudan University) : Chirality, Magnetic Fields and Spin Polarization

Heavy-ion collisions produce extremely hot quark-gluon matter with extremely strong magnetic fields and fluid vorticity. The responses of the hot quark-gluon matter to the magnetic field and vorticity exhibit novel quantum phenomena closely related to spin degree of freedom of the quarks, for example, the famous chiral magnetic and vortical effects and the spin polarization of hyperons and vector mesons. We will discuss some special properties of the magnetic field and vorticity in heavy-ion collisions and then will focus on the phenomenology of chiral magnetic effect and hyperon spin polarization in heavy-ion collisions.

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5. Guangyou Qin (CCNU) : Study of QGP through jet quenching

The strongly-interacting quark-gluon plasma was one of the most important discoveries in relativistic heavy-ion collisions at RHIC and the LHC. Jet quenching, mainly characterized by parton energy loss and transverse momentum broadening, provides one of the important tools to study the properties of such hot and dense QCD matter. In this talk, I will present some recent works on jet-medium interaction, with focus on the flavor hierarchy of jet quenching, and the nuclear modifications of full jet rates and structures.

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

The 101st HENPIC seminar by Dr. Mamiya Kawaguchi, Fudan University， April 23rd, 2020, Thursday, 10:30am (Beijing time)

Title: Anomalous transport from scale symmetry

Abstract:
The anomalous transport (current) induced from the chiral anomaly has been extensively studied in strong electromagnetic field regions relevant to the heavy ion collision in order to reveal the novel aspect for understanding the QCD phase structure. Paying an attention to the scale symmetry of QCD, the scale anomaly is also closely tied with the vacuum structure of QCD. Thus, in nonzero electromagnetic fields the QCD scale anomaly would be expected to generate new anomalous currents involving the essential feature of QCD. In this seminar, I will talk about the anomalous current induced by the scale anomaly based on the dilaton effective model.

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

The 102nd HENPIC seminar by Prof. Hongxi Xing (邢宏喜), South China Normal University， April 30th, 2020, Thursday, 10:30am (Beijing time)

Title: Deciphering the nature of X(3872) in heavy ion collisions

Exploring the nature of potential exotic candidates such as the X(3872) plays a pivotal role in understanding the Quantum Chromodynamics (QCD). Despite significant efforts, consensus on their internal structures is still lacking. In this talk, we will show the unique opportunity to decipher the X(3872) state in heavy ion collisions. In particular, the fireball volume created in heavy ion collisions plays a crucial role, leading to markedly different centrality dependence and production yields of X(3872) between hadronic molecules and compact tetraquarks configurations. Other opportunities to pin down the inner structure of X(3872) will be also presented.

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

The 103rd HENPIC seminar by Dr. Shuzhe Shi (施舒哲), McGill University, May 7th, 2020, Thursday, 10:30am (Beijing time)

Title: Spin Hydrodynamics from Both Microscopic and Macroscopic Approaches

Abstract:
As a conserved quantity in the evolution of the quark-gluon plasma (QGP) created in heavy-ion collisions, the total angular momentum consists of two sectors: the orbital angular momentum (OAM) caused by kinetic motion, and the intrinsic spin angular momentum of quarks and gluons. In a heavy-ion collision event, the system starts with finite OAM but un-polarized spin density (unless prepared specifically). Microscopic scattering processes allow a coupling between these two components. Therefore, spin polarization can eventually develop and may have a non-trivial influence on the QGP evolution. A hydrodynamic theory, with the aforementioned spin polarization effect properly taken into account, is required, especially for quantitative studies of the polarization rate of observed hadrons, e.g. Λ-hyperon.The latter has been observed in RHIC experiment, serving as an evidence of the most vortical fluid in the universe. In this talk, we will construct the dissipative spin hydrodynamics from two approaches – from (microscopic) kinetic theory, and from macroscopic principles.

Firstly, we start with chiral kinetic theory and construct the {\bf spin hydrodynamic framework} for a chiral spinor system. We obtain the equations of motion of second-order dissipative relativistic fluid dynamics with non-trivial spin polarization density. In a chiral spinor system, the spin alignment effect could be treated in the same framework as for Chiral Vortical Effect (CVE). However, the fluid vorticity induces not only the CVE current but also asymmetric stress tensor as well as spin polarization of final state hadrons, all of which emerge as quantum corrections.
Then, we will compare the results with what one can get from macroscopic principles, i.e. conservation laws and second law of thermodynamics. Compared to previous results from the same approach, we find extra terms could exist without violating the aforementioned macroscopic principles.

CV:
currently a PostDoc at McGill University, working with Dr. Charles Gale and Sangyong Jeon.
I obtained my M.S. from Tsinghua University (with Dr. Pengfei Zhuang) and Ph.D. from Indiana University, Bloomington (with Dr. Jinfeng Liao).

Primary author: SHI, Shuzhe (McGill University)

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

The 104th HENPIC seminar by Dr. Xin-li Sheng (盛欣力), University of Sci.&Tech. of China (USTC), May 14th, 2020, Thursday, 10:30am (Beijing time)

Title: From spin polarization of quarks to global spin alignment of ϕ mesons

Speaker : Dr. Xin-li Sheng (盛欣力), University of Sci.&Tech. of China (USTC)

Abstract:
The STAR preliminary data for ϕ meson ' s spin alignment ρ_{00} is significantly larger than 1/3, which is beyond our current understanding of the polarization. In this seminar, I will first show how to derive the global thermal equilibrium distribution from the kinetic theory for massive spin-1/2 fermions. Such a distribution gives the spin polarization of quarks in vorticity and electromagnetic fields. With the help of coalescence model, the spin alignment of ϕ mesons was constructed. We will see that a large positive derivation of ρ_{00}^{ϕ} from 1/3 may be the result of a mean field of ϕ instead of the vorticity field or the electromagnetic field.

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

The 105th HENPIC seminar by Dr. Lipei Du (杜立配), Ohio State University, May 21st, 2020, Thursday, 10:30am (Beijing time)

Title: Hydrodynamics at non-zero net baryon density and fluctuation dynamics near the QCD critical point

Speaker : Dr. Lipei Du (杜立配), Ohio State University

Abstract:
Dissipative relativistic fluid dynamics has been unexpectedly successful in describing the evolution of the hot and dense fireballs created in relativistic light- and heavy-ion collisions at very high collision energies, and the distributions of particles emitted from them. I will discuss two recent developments that extend the applicability of the approach to lower collision energies: (1) the consistent evolution of the net baryon density and of the dissipative baryon diffusion current which are both non-zero and possibly large at lower collision energies (arXiv: 1906.11181); and (2) the non-hydrodynamic evolution of critical slow modes coupled to the hydrodynamic evolution of the medium as it passes by the critical point in the QCD phase diagram, using the newly developed HYDRO+ framework (arXiv: 2004.02719). These developments can provide guidance for future realistic simulations of heavy-ion collisions aiming at finding possible signals and the location of the QCD critical point.

Self-introduction: Lipei Du (杜立配), PhD student at The Ohio State University (2015-present), main research interest lies in theoretical modeling of heavy-ion collisions at Beam Energy Scan energies, including hydrodynamics at non-zero net baryon density and dynamics near the QCD critical point.

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

INT Workshop 2020: Chirality and Criticality, May 11 - May 22, 2020

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

The 106th HENPIC seminar by Dr. Daniele Paolo Anderle, South China Normal University, May 28th, 2020, Thursday, 2:00pm (Beijing time)

Fragmentation Functions in the era of the EIC

Speaker : Dr. Daniele Paolo Anderle

Abstract : We present the latest developments in collinear fragmentation functions' analyses and discusstheir possible improvement with the future electron-ion collider experiments. A rst precisionextraction of parton-to-pion fragmentation functions at next-to-next-to-leading order based onsingle-inclusive pion production in electron-positron annihilation is presented. Moreover, a secondanalysis of the same type with reduced lower z cuts is discussed. Here, the extension to the smallz-region is achieved by means of an all order resummation of large logarithmic contributions.Further measurements are shown to be necessary in order to extend high precision extractionsof FF in the small-z region.Using the same framework we nally present the rst global analysisof D-meson fragmentation functions at next-to-leading order. A consistent set of fragmentationfunctions is obtained using the available data for the processes: e+e->D*X, pp->D*X*, and thein-jet fragmentation function pp->(jet D*)X

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

The 107th HENPIC seminar by Dr. Wenbin Zhao (赵文彬), Peking University, June 4th, 2020, Thursday, 10:30 am (Beijing time)

Title: Collectivity & QGP signals in Large and Small systems

Speaker : Dr. Wenbin Zhao , Peking University

Abstract: The collective flow and the possible formation of the Quark-Gluon Plasma (QGP) in the small colliding systems are hot research topics in the heavy-ion community. For heavy-ion collisions, the strong collective flow, NCQ scaling and jet quenching effects are three key evidences for the formation of QGP. Recently, ALICE, ATLAS and CMS collaborations have measured the strong collective flow and the related number of constituent quark (NCQ) scaling of identified hadrons in p+p and p+Pb collisions at LHC, which are important observables for the possible hydrodynamic evolutions and to probe the partonic degree of freedom in the created small system. In this talk, we focus on the hydrodynamic model calculations for collective flow at low p_T for p+p collisions and the coalescence model calculations for the NCQ scaling of v_2 at intermediate p_T for the high multiplicity p+Pb collisions. For hydrodynamics in p+p collisions, with properly tuned parameters, iEBE-VISHNU hybrid model can describe the measured 2-particle correlations, However, our model calculations shows positive 4-particle cumulant $c_2\{4\}$, and cannot reproduce the negative $c_2\{4\}$ measured in experiment. For the quark coalescence model calculations for the NCQ scaling, it includes thermal-thermal, thermal-jet and jet-jet partons recombinations, using the thermal partons from hydrodynamics and jet partons after the energy loss of the Linear Boltzmann Transport (LBT) model. Such coalescence model calculations have also been smoothly connected with the low p_T hydrodynamic calculation and high p_T jet fragmentation. Within such combined framework, we present a nice description of the spectra and elliptic flow over the p_T range from 0 to 6 GeV, and obtain the approximately NCQ scaling at intermediate p_T as measured in experiment. We also switch off the coalescence process of partons and find that without such coalescence, one cannot describe the differential elliptic flow and related NCQ scaling at intermediate p_T. Such comparison calculations also demonstrate the importance of the partonic degree of freedom and indicate the possible formation of QGP in the high multiplicity p+Pb collisions.

1 W. Zhao, Y. Zhou, H. Xu, W. Deng and H. Song, Phys. Lett. B 780, 495 (2018).

[2] W. Zhao, Y. Zhou, K. Murase and H. Song, arXiv:2001.06742 [nucl-th].

[3] W. Zhao, C. M. Ko, Y. X. Liu, G. Y. Qin and H. Song, arXiv:1911.00826 [nucl-th].

[4] W. Zhao, C. M. Ko, Y. X. Liu, G. Y. Qin and H. Song, arXiv:2001.10689 [nucl-th].

[5] Y. Zhou, W. Zhao, K. Murase and H. Song, arXiv:2005.02684 [nucl-th].

[6] W. Zhao, H. j. Xu and H. Song, Eur. Phys. J. C 77, no. 9, 645 (2017).

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

The 108th HENPIC seminar by Dr.Huilin Qu (曲慧麟), University of California, Santa Barbara (UCSB), June 11th, 2020, Thursday, 3:00 pm (Beijing time)

Talk title: Jet Tagging via Particle Clouds

Speaker : Dr. Huilin Qu (曲慧麟)，University of California, Santa Barbara (UCSB)

[Abstract]
Machine learning techniques have brought a lot of progress in jet physics in recent years. One of the key questions in machine learning on jet physics is how to represent a jet. Inspired by the notion of point clouds, we propose a new approach that considers a jet as an unordered set of its constituent particles, effectively a "particle cloud". Such a particle cloud representation of jets is efficient in incorporating raw information of jets and also explicitly preserves permutation symmetry. Based on the particle cloud representation, we propose ParticleNet, a customized neural network architecture using Dynamic Graph CNN for jet tagging problems. The ParticleNet architecture achieves state-of-the-art performance on jet tagging problems and improves significantly over existing methods. The particle cloud representation provides a natural and generic way of representing jets and can be applied to a broad range of high energy physics problems.

[Speaker CV] Huilin Qu (UCSB)
Huilin Qu is currently a postdoctoral researcher at University of California, Santa Barbara (UCSB). Huilin obtained his Ph.D. in physics from UCSB in 2019. His research is primarily focused on the measurement of Higgs boson properties and the search for physics beyond the standard model with the CMS experiment. In addition, he is also active in the development and application of machine learning techniques for high energy physics.

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

The 109th HENPIC seminar by Dr. Qian Yang (杨钱), Shandong University (山东大学), June 18th, 2020, Thursday, 10:30 am (Beijing time)

Talk title: J/ψ production within a jet in p+p and heavy-ion collisions

Speaker : Dr. Qian Yang (杨钱), Shandong University (山东大学)

Abstract:
The suppression of J/ψ production caused by the color-screening effect in heavy-ion collisions is considered as an evidence of the creation of quark-gluon plasma.To interpret the observed suppression in heavy-ion collisions, a good understanding of its production mechanism in p+p collisions is needed. However,the production of J/ψ in hadronic collisions remains not fully understood and requires further studies. Recently, J/ψ production in jets was proposed as a useful observable to help explore the J/ψ production mechanism, and to differentiate various J/ψ production models.In this seminar, I will discuss measurements of J/ψ production within a jet from both RHIC and LHC energy.The measurements in p+p collision from both RHIC and LHC indicate different trend and less isolated production than PYTHIA8. The measurement from heavy-ion collisions support an interpretation of jet quenching as a relevant mechanism for J/ψ suppression. The physics implications and comparison between different measurements will be also discussed.

Qian Yang (Shandong University), He is currently a Associate Research Scientist at Shandong University. Qian obtained his Ph.D in physics from USTC in 2017. His research is primarily focused on measurements of heavy quarkonium production, especially on J/psi production mechanism study in p+p collisions at RHIC energy.

Primary author: YANG, Qian (Shandong University)

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

The 110th HENPIC seminar by Dr. Volodymyr Vovchenko, Lawrence Berkeley National Lab, June 25th, 2020, Thursday, 10:30 am (Beijing time)

Talk title: Recent results on light nuclei production in extended thermal model descriptions

Speaker : Dr. Volodymyr Vovchenko, Lawrence Berkeley National Lab

Abstract:
I will present recent results on light nuclei production in relativistic heavy-ion collisions within two extensions of the thermal model approach. First, a canonical formulation of the statistical model will be exploited to analyze the suppression of light nuclei abundances in small systems created in pp and pA collisions at the LHC. Second, the evolution of light nuclei yields during the long-lived hadronic phase in central collisions of heavy ions is described using the cosmological Saha equation approach, providing clues to the remarkable success of thermal models in describing the production of loosely bound states. Finally, I will discuss the feeddown contributions from excited nuclear states, which are found to be sizable at energies corresponding to the RHIC beam energy scan.

Short self-introduction:

- Master degree in 2013 at Taras Shevchenko National University of Kyiv, Ukraine.
- PhD at Goethe University Frankfurt in March 2018, under Prof. Horst Stoecker. The PhD thesis title is “Quantum statistical van der Waals equations and its QCD applications”, featured in a PRL article https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.118.182301
- First postdoc appointment is with Prof. Carsten Greiner at Goethe University Frankfurt from March 2018 to February 2020. The main topics include the QCD equation of state and light nuclei production in heavy-ion collisions.
- Since Feb 2020 a postdoc in Nuclear Theory Group at LBNL as a Feodor Lynen Research Fellow of the Alexander von Humboldt Foundation.

Personal homepage: http://vovchenko.net

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

The 111th HENPIC seminar by Dr. Weiyao Ke (柯伟尧), UC Berkeley&Lawrence Berkeley National Laboratory, July 2nd, 2020, Thursday, 10:30 am (Beijing time)

Talk title: Jet properties in heavy-ion collisions from a transport model perspective

Speaker : Dr. Weiyao Ke (柯伟尧), UC Berkeley&Lawrence Berkeley National Laboratory

Abstract:
Relativistic heavy-ion collisions produce hot and dense QCD medium. Jets, initiated by hard processes in these collisions, propagate through and interact with this color opaque medium. Studying the modifications to the properties of jets relative to those measured in proton-proton collisions helps to reveal the jet-medium interactions. In this work, we try to understand the medium modifications to jets in a linearized partonic transport model. The time-evolution of hard partons is coupled to a 2+1D viscous hydrodynamic modeling of the medium. The jet-medium interactions include both elastic collisions and medium induced radiations, as well as a simple model for jet induced medium excitations. We looked at high p_T inclusive hadron R_{AA}, jet R_{AA}, and jet shape modifications to understand the roles played by different mechanisms. We found that the suppression of the hardest constituents–leading particles–is largely due to medium-induced radiation process; while elastic collisions and medium excitations are essential to understand jet suppression and the energy redistribution at large-r. Finally, we discuss the implications of the constraining power of the jet transport parameters in the hot QCD medium using the transport model approach.

Profile:
Weiyao Ke (UCB & LBNL). Weiyao Ke is currently a postdoctoral researcher at the University of California, Berkeley, and Lawrence Berkeley National Laboratory. He received his Ph.D. in physics from Duke University in 2019. His primary research interests are the development and application of transport theory to heavy flavor and jet modifications in nuclear environments. Other interests include the application of the Bayesian inference technique to heavy-ion physics phenomenology.

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

The 112nd HENPIC seminar by Dr. Tu Zhoudunming (涂周顿明), Brookhaven National Laboratory, US, July 9th, 2020, Thursday, 10:30 am (Beijing time)

Talk title: Probing quantum entanglement of partons in high energy collisions.

Speaker : Dr. Tu, Zhoudunming (涂周顿明), Brookhaven National Laboratory, US

Abstract:
The confinement of quarks and gluons, the building blocks of all visible matter, is perhaps the ultimate example of quantum entanglement. Inside nucleons they are not just correlated, they do not even exist as isolated states. However, in the parton model formulated by Bjorken, Feynman, and Gribov, the partons are viewed by an external hard probe as independent when the nucleon is boosted to an infinite-momentum frame. Therefore, the parton probed by a virtual photon is causally disconnected from the rest of proton. It has been recently proposed that this apparent paradox can be resolved by quantum entanglement of partons, possibly manifesting itself in observables related to hadron multiplicities. In this talk, I will briefly introduce the idea of measuring the entanglement entropy using final-state hadron multiplicities, and its test in proton-proton collisions based on the LHC data. In addition, I will focus on testing this idea in deep inelastic scattering of ep collisions using the H1 data. Finally, possible future measurements at the EIC will be discussed.

Profile:

Tu, Zhoudunming (涂周顿明), I received my Ph.D in 2018 from Rice University based on the CMS experiment with a focus of heavy ion physics. I had worked on physics topics that are mostly related to particle correlations. After my Ph.D, I joined Brookhaven National Lab as a Goldhaber fellow, working on the project of the Electron-Ion Collider. Currently, my physics interest involves both nuclear and particle physics, from nuclear short-distance dynamics to low-x/spin physics in ep, eD/He3, and eA collisions.

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

The 113rd HENPIC seminar by Dr. Jasmine Brewer, Massachusetts Institute of Technology (MIT), July 16th, 2020, Thursday, 10:30 am (Beijing time)

Talk title: Equilibration and jets in the quark–gluon plasma

Speaker : Dr. Jasmine Brewer, Massachusetts Institute of Technology (MIT)

Abstract:
Heavy-ion collision experiments provide a unique window into the structure of the high-temperature phase of QCD, the quark–gluon plasma. In this talk we will address aspects of two conceptual approaches to studying the quark–gluon plasma: the emergence of hydrodynamic behavior and the modification of jets.

First, we describe a new scenario characterizing the transition of the quark-gluon plasma from a highly non-equilibrium state at early times toward a fluid described by hydrodynamics at late times. In this scenario, the bulk evolution is governed by a set of slow modes that are "pre-hydrodynamic" in the sense that they are initially distinct from, but evolve continuously into, hydrodynamic modes in hydrodynamic limit. We explicitly identify the pre-hydrodynamic modes for a kinetic description of weakly-coupled Bjorken expanding plasma and demonstrate in the relaxation-time approximation that the full kinetic theory evolution is indeed dominated by these modes.

Second, we discuss a data-driven method to estimate the separate energy loss and modification of quark- and gluon-initiated jets in the quark–gluon plasma using a statistical technique called topic modeling. Assuming that jet distributions are a mixture of underlying "quark-like" and "gluon-like" distributions, we show how to extract quark and gluon jet fractions and constituent multiplicity distributions as a function of the jet transverse momentum. These results suggest the potential for an experimental determination of quark and gluon jet modifications.

Profile: Jasmine Brewer is currently a Ph.D. candidate in physics at MIT and will be starting in the fall as a fellow at CERN. Her primary research interests are in jet modification in heavy-ion collisions and the far-from-equilibrium evolution of the quark-gluon plasma.

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

The 114th HENPIC seminar by Prof. Hideki Hamagaki (Nagasaki Institute of Applied Science), July 23rd, 2020, Thursday, 10:30 am (Beijing time)

Talk title: Study of Exotic Particles using High Energy Heavy Ion Collisions

Speaker : Prof. Hideki Hamagaki (Nagasaki Institute of Applied Science)

Abstract:
Possibility of studying exotic particles utilizing the high-energy heavy-ion collisions has been considered since the onset of studies at LBL-BEVALAC. Notable study at BNL-AGS was the search for strangelet, an ultimate form of dense nuclear matter. Recently at colliders, BNL RHIC and CERN LHC, interesting studies have been performed; one on the di-baryons with strangeness and the other on the pentaquarks. In this seminar, after brief historical introduction of the old studies, I will mainly concentrate on the recent progress on the studies of di-baryons at RHIC and LHC. I will also present prospect of the studies mainly at LHC in near future.

Introduction of myself in brief: I am currently a professor of Nagasaki Institute of Applied Science, since April, 2016. I have been a professor of Center for Nuclear Study, University of Tokyo beforehand. I have been interested in nuclear and quark matter under extreme conditions, and I have been studying experimentally the properties of such matter with high energy heavy ion collisions since 1980. After spending several years at LBL BEVALC, I moved to AGS at BNL. I conducted the AGS E866 experiment to measure proton density at central rapidity in Au + Au collisions. At RHIC, I have been involved in the PHENIX experiment from the design stage. I was in charge of construction and operation of RICH (Ring Imaging CHerenkov Counter), which was the primary device for electron identification. In 2010, I joined the ALICE experiment at CERN. I have some expertise in the GEM detector, and I have been involved in the ongoing ALICE TPC upgrade.

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

The 115th HENPIC seminar by Daniel Brandenburg (Brookhaven National Lab), July 30th, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Observation of the Breit-Wheeler Process in Heavy-Ion Collisions

Speaker : Dr. Daniel Brandenburg (Brookhaven National Lab)

Abstract:
Ultra-relativistic heavy ion collisions are expected to produce some of the strongest magnetic fields ($10^{13} - 10^{16}$ Tesla) in the Universe1. Recently, there has been increased interest in the magnetic fields produced by heavy ion collisions and their possible observational impacts through emergent magnetohydrodynamical phenomena in Quantum Chromodynamics, like the Chiral Magnetic Effect[2]. The initial strong electromagnetic fields produced in heavy ion collisions have been proposed as a source of linearly-polarized, quasi-real photons[3] that can interact via the Breit-Wheeler process to produce e^+e^- pairs[4].

In this talk I present STAR measurements of e^+e^- pair production in ultra-peripheral and peripheral Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. A comprehensive study of the pair kinematics is presented to distinguish the $\gamma\gamma \to e^+e^-$ process from other possible production mechanisms.
Furthermore, the measured distribution of e^+e^- pairs reveals a striking fourth-order angular modulation which is related to vacuum birefringence[5], a phenomenon predicted in 1936 in which empty space can split light according to its polarization components when subjected to a strong magnetic field. These measurements provide the first direct experimental evidence that ultra-relativistic heavy ion collisions are capable of producing the strongest magnetic fields in the known Universe over an extended spatial distribution.

1 V. Skokov, A. Illarionov, and V. Toneev. International Journal of Modern Physics A 24 (2009): 5925–32.

[2] Kharzeev, D. E., et al. Prog. Part. Nucl. Phys., 88 (2016)1–28

[3] C. Weizsäcker, Zeitschrift für Physik 88 (1934): 612–25.

[4] G. Breit and J. A. Wheeler. Physical Review 46 (1934): 1087

[5] Heisenberg, W., and H. Euler. Zeitschrift für Physik, (1936) arXiv: physics/0605038

Self-introduction: My name is Daniel Brandenburg. I graduated from Rice University in 2018. Asa PhD student I worked on measurements of jet quenching signatures as partof the Beam Energy Scan phase I and performed the first STAR measurement ofdimuon production. I am currently a Goldhaber Fellow at BrookhavenNational Laboratory (BNL). Before that I was in a joint Postdoc

positionbetween BNL and SDU (2018 - 2020). While at BNL I have taken a leadershipposition as the software coordinator in STAR's ongoing forward rapidityupgrade program. My physics interests are focussed on ultra-peripheralcollisions and the ongoing Beam Energy Scan phase 2 and the opportunitiesto study the possible QCD critical point.

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

The 116th HENPIC seminar by Dr. Rongrong Ma (Brookhaven National Lab), Aug. 6th, 2020, Thursday, 10:30 am (UTC+8)

Title: Probe the Quark Gluon Plasma with Quarkonia at the STAR Experiment

Speaker: Rongrong Ma (Brookhaven National Laboratory)

Abstract: The quark-gluon plasma (QGP) is believed to have existed in the early universe, and can be created in laboratory through ultra-relativistic heavy-ion collisions. Among various probes used to study the properties of the QGP, quarkonia play a special role as they are expected to dissociate in the medium due to the color screening of the quark-antiquark potential by the surrounding partons. Such a dissociation occurs when the quarkonium size exceeds the medium Debye radius, which is inversely proportional to the medium temperature. Consequently, quarkonium suppression was proposed as a direct evidence of the QGP formation in heavy-ion collisions. Furthermore, the three bottomonium states of different binding energies are expected to dissociate at different temperatures, which can be used to constrain the temperature of the QGP. To aid the interpretation of the observed quarkonium suppression in heavy-ion collisions, the corresponding Cold Nuclear Matter (CNM) effects, arising from the presence of heavy nuclei in the collisions but not related to the QGP, also need to be understood.

In this talk, I will discuss the latest measurements of J/⊠ and ϒ production in p+p collisions at sqrt(s) = 200 and 500 GeV, as well as in p+Au and Au+Au collisions at sqrt(sNN) = 200 GeV by the STAR experiment at RHIC. The J/⊠ suppression in Au+Au collisions is measured as functions of J/⊠ transverse momentum (pT) over a wide range, and of collision geometry. A strong suppression of high-pT J/⊠ is observed in central Au+Au collisions. On the other hand, a sequential suppression pattern is observed for the ϒ family, with the excited states more suppressed than the ground state. These measurements are compared with model calculations and physics implications will be discussed.

CV: I graduated from the Peking University in 2008 with a Bachelor's degree, and went onto the Yale University as a Ph. D candidate. During my graduate years, I worked on measurements of inclusive jet cross-section in p+p collisions and semi-inclusive jet suppression in heavy-ion collisions with the ALICE experiment at CERN. After receiving my Ph. D. from Yale, I came to the Brookhaven National Laboratory first as a post-doc, and then as a Goldhaber Fellow. I also transitioned to carry out quarkonium measurements in heavy-ion collisions utilizing the Muon Telescope Detector fully installed in 2014. I became an assistant physicist at BNL in 2017, and then an associate physicist until now. My research interests are using quarkonium and heavy-flavor jets to study the properties of the quark-gluon plasma.

Contribution ID: **46** Type: **not specified**

The 117th HENPIC seminar by Prof. Zhongbo Kang (University of Califorlia, Los Angeles), Aug. 13th, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Jets for 3D imaging

Speaker : Prof. Zhongbo Kang (University of Califorlia, Los Angeles)

Abstract: At present day collider experiments such as the Large Hadron Collider (LHC) and the Relativistic Heavy Ion Collider (RHIC), energetic jets play an important role as precision probes of the Standard Model and beyond. In recent years, measurements at RHIC and LHC demonstrate that jets can be a useful probe for the QCD structure of the nucleon. In this talk, I review some recent excitement in utilizing jets for 3D imaging of the nucleon, which is one of the major pillars of the future Electron Ion Collider in US. I discuss how such new opportunities would complement the traditional processes such as semi-inclusive deep inelastic scattering, Drell-Yan production, and e+e- collisions.

Self-introduction: Zhongbo is currently an assistant professor at Department of Physics and Astronomy, and Bhaumik Institute for Theoretical Physics at University of California Los Angeles (UCLA). He is also an associate member of Center for Frontiers in Nuclear Science (CFNS) of Stony Brook University and Brookhaven National Laboratory. Before he joined UCLA in 2016, Zhongbo has worked at Los Alamos National Laboratory, first as a Director's postdoctoral associate, a J. Robert Oppenheimer Fellow, and then a staff scientist. He has also worked at RIKEN BNL Research Center as a research associate. He has won an early CAREER award from National Science Foundation.

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

The 118th HENPIC seminar by Prof. Xin-Nian Wang (CCNU/LBNL), Aug. 20th, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Jet tomography of hot and cold nuclear matter 1

Speaker : Prof. Xin-Nian Wang (CCNU/LBNL)

Abstract:
When an energetic parton propagates through hot or cold nuclear matter, it will interact with the constituents of the matter. The energy loss and momentum broadening it experiences along its propagation path is the subject of intense experimental and theoretical studies. What we have learned about this within perturbative QCD has enabled us to use fast partons or jets as a tomographic tool to glean properties of the hot/dense and cold nuclear matter from experimental data of heavy-ion and electron-ion collisions. I will give a brief review on theoretical and phenomenological studies of jet tomography and discuss what we have and will learn about properties of hot and cold nuclear matter in these experiments.

1 S. Cao and X.-N. Wang, Jet quenching and medium response in high-energy heavy-ion collisions: a review [arXiv:2002.04028 [hep-ph]].

Self-introduction:

Xin-Nian Wang, currently a professor and the director of the Institute of Particle Physics at Central China Normal University (CCNU) and Senior Scientist at the Lawrence Berkeley National Laboratory (LBNL). He was awarded Ph. D. in physics at the University of Oregon in 1989 and then went to LBNL (1989-91) and Duke University (1991-92) as a postdoctoral fellow. He was appointed as a Divisional Fellow at the LBNL in 1992, became a Senior Scientist in 1997 and was the head of the Nuclear Theory Program during 1999-2007. His main research interest is in high-energy particle and nuclear physics, especially in the search for a new form of matter known as the Quark-Gluon Plasma in high-energy heavy-ion collisions.

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

The 119th HENPIC seminar by Dr. Kaijia Sun (Texas A&M University), Aug. 27th, 2020, Thursday, 10:30 am (UTC+8)

Talk title: QCD criticality on light nuclei production in heavy-ion collisions

Speaker : Dr. Kaijia Sun (Texas A&M University)

Abstract: Locating the possible critical (end-)point (CEP), characterized by a diverging density-density correlation length,
in the phase diagram of Quantum Chromodynamics (QCD) through the Beam Energy Scan (BES) program
at RHIC is one of the main goals in high-energy nuclear physics. Since the proposal of using the non-Gaussian fluctuations (PRL 102,032301(2009)) in the net-proton multiplicity distribution as the probe to the CEP almost one decade ago, little progress has been made in identifying other observables that are sensitive to the CEP. In this talk, I show, for the first time, that the yield ratios of light nuclei, such as $N_t N_p/N_d^2$, $N_\alpha N_p/(N_{^3He} N_d)$,
and $N_\alpha N_t N_p^2/(N_{^3He} N_d^3)$, increase monotonically as a function of the correlation length.
This novel phenomenon of criticality allows us to locate the QCD critical point through the collision energy
dependence of the yield ratio $N_t N_p/N_d^2$ in relativistic heavy-ion collisions.

Self-introduction:Kai-Jia Sun, currently a postdoc of the Cyclotron institute in Texas A&M University (TAMU).
He was awarded Ph. D. in physics at Shanghai Jiao Tong University (SJTU) in 2017 and then went to TAMU as a postdoctoral fellow. His main research interest is in high-energy nuclear physics, especially in the search for the QCD critical point in relativistic heavy-ion collisions.

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

The 120th HENPIC seminar by Dr. Benjamin Nachman (LBNL), Sep. 3rd, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Jet Substructure and Machine Learning

Speaker : Dr. Benjamin Nachman (LBNL)

Abstract:
We are in the midst of a QCD renaissance, with significant advances in both experimental and theoretical studies of jet substructure. I will discuss recent developments from the ATLAS experiment, where we are using jets in new ways to measure fundamental parameters of the Standard Model, search for new particles, study quantum properties of inherently interesting emergent phenomena, and tune Monte Carlo event generators. Machine learning is a disruptive technology that is allowing us to study jets holistically in their natural high dimensionality. In the second part of the talk, I will discuss new directions in jet substructure using machine learning for both measurements of the Standard Model and searches for new physics.

Self-introduction:
Benjamin Nachman, B.A. in Physics, Mathematics and Economics from Cornell University in 2012, Churchill Scholarship (Applied Mathematics) at Cambridge in 2013, Ph.D. from Stanford University in 2016, Chamberlain Fellowship at Lawrence Berkeley National Laboratory 2016-2020, currently Staff Scientist at Lawrence Berkeley National Laboratory.

Primary author: Dr NACHMAN, Benjamin (LBNL)

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

The 121st HENPIC seminar by Prof. Toru Kojo (CCNU), Sep. 10, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Hard-core deconfinement and soft-surface delocalization from nuclear to quark matter

Speaker : Prof. Toru Kojo (CCNU)

Abstract:
We propose a novel concept of hard and soft realizations of deconfinement from nuclear to quark matter. Hard Deconfinement takes place when bulk thermodynamics is dominated by the core properties. The energy density and mechanical pressure in a nucleon, which are related to the gravitational form factor in scattering experiments, are found to be consistent with high density constraints known from neutron star phenomenology. Meanwhile Soft Deconfinement is driven by quark exchanges at intermediate distance and begins before Hard Deconfinement happens. To describe this phenomenon we use a model of quantum percolation, and discuss a quantum mechanical problem of quarks hopping among baryons. We describe delocalization of quark wavefunctions as well as the Anderson localization. Finally we discuss how the quark Fermi sea is developed as nuclear matter transforms into quark matter, and conjecture a scenario leading to a momentum shell model in Quarkyonic Matter.

Self-introduction:
Toru Kojo, Ph.D. from Kyoto University in 2008, a postdoc at RIKEN BNL for 2008-2011, a postdoc at Bielefeld university in 2011-2013, a research associate at University of Illinois at Urbana-Champaign in 2013-2015, currently an associate professor at Central China Normal University since 2015. He is working on QCD in extreme conditions and nuclear astrophysics.

Presenter: Prof. KOJO, Toru (CCNU)

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

The 122nd HENPIC seminar by Dr. Anping Huang 黄安平 (Indiana U.), Sep. 17, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Dynamical evolution of magnetic fields in heavy-ion collisions

Speaker : Dr. Anping Huang (Indiana University)

Abstract:
The electromagnetic fields in heavy-ion collisions are important ingredients for many interesting phenomena, such as Chiral Magnetic Effect (CME) and the directed flow v_1 of Dˆ0 mesons. A critical and challenging problem in this direction is the dynamical evolution of the magnetic field in the medium. The magnetic fields from the initial colliding nuclei decay very fast in the vacuum. Nevertheless, it has been proposed that its lifetime could be extended through medium response. We focus on the dynamical electromagnetic fields in heavy-ion collisions by numerical solving the Maxwell equations together with the hydrodynamically expanding medium, by assuming negligible backreaction of the fields on the fluid evolution. In this talk, I will present our latest results for the time-dependent magnetic fields in this newly developed framework.

Self-introduction:
Dr. Anping Huang obtained Ph.D under the supervision of Prof. Pengfei Zhuang from Tsinghua University in 2018. After a first postdoc position at Tsinghua University for 2018-2019, he has been a postdoc researcher at Indiana University since 2019. He has done a number of notable works on quantum kinetic theory, and more recently his research focuses on the dynamical evolution of electromagnetic fields in heavy ion collisions.

Presenter: Dr HUANG, Anping

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

The 123rd HENPIC seminar by Prof. Shanshan Cao 曹杉杉 (Shandong U.), Sep. 24, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Probing heavy flavor hadronization with hadron chemistry in heavy-ion collisions

Speaker: Prof. Shanshan Cao (Shandong University)

Abstract:
A solid hadronization model is essential for understanding hadronic observables in high-energy nuclear collisions, while still remains a challenge due to its non-perturbative nature. We have developed a hadronization model for heavy quarks and studied their suppression, flow and hadron chemistry in heavy-ion collisions. A complete set of both s and p-wave hadronic states are included, which naturally cover all major heavy flavor hadron states observed in the Particle Data Group, and normalize the coalescence probability of zero momentum heavy quarks with proper hadron sizes. With a strict energy-momentum conservation implemented, the boost invariance of the coalescence probability and the thermal limit of the produced hadron spectrum are respected. By combining this newly developed hadronization scheme with a Langevin-hydrodynamics model that incorporates both elastic and inelastic energy loss of heavy quarks inside the realistic QGP medium, we provide a good description of the nuclear modification factor and elliptic flow of D mesons, as well as the corresponding flavor hierarchy between D and B-decayed electrons. A good description of the charmed hadron chemistry—both pT-integrated and differentiated Λc/D0, Ds/D0 and Bs/B+ ratios—is obtained at both RHIC and LHC. Systematic uncertainties of our model calculations will also be discussed in detail in the end.

Self-introduction:
Shanshan Cao, currently a professor at Shandong University, got his Ph.D from Duke University in 2014, and worked as postdoc at Lawrence Berkeley National Laboratory from 2014 to 2016, and Wayne State University from 2016 to 2020. His research focuses on theoretical high-energy nuclear physics, in particular, probing properties of the quark-gluon plasma with jets and heavy quarks.

Presenter: Prof. CAO, Shanshan

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

The 124th HENPIC seminar by Prof. Jun Song 宋军 (Jining U.), Oct. 15, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Hadron production by equal-velocity quark combination mechanism in high energy collisions

Speaker: Prof. Jun Song (Jining University)

Abstract: Hadronization is the process of the formation of hadrons out of final state quarks and gluons in high energy reactions. Because QCD dynamics of the hadronization are not yet fully understood, hadronization is modeled and parameterized in various phenomenological studies closely interacting with experimental data of high energy reactions. In recent works, we found that experimental data for transverse momentum (⊠⊠) spectra of hadrons in high multiplicity events of ⊠⊠ and ⊠Pb collisions at LHC energies exhibit a quark number scaling (QNS) property. This QNS is the direct consequence of combination hadronization of quarks and antiquarks with equal velocity (EVC). We found that EVC of light-flavor quarks as well as charm quarks can self-consistently describe the ⊠⊠ spectra of light-flavor hadrons and those of single-charmed hadrons in ⊠⊠ and ⊠Pb collisions at LHC. Furthermore, we applied EVC to heavy-ion collisions at RHIC and LHC. We found that experimental data of hadronic elliptic flow can be understood in an amazingly simple way under EVC mechanism. We made a full energy-scan study for hadronic ⊠⊠ spectra and yield densities at midrapidity in Au+Au collisions at collision energy of 7.7–200 GeV to systematically test EVC mechanism.

Self-introduction: Jun Song, currently a professor at Jining University, obtained his Ph.D from Shandong University in 2011. His research focuses on the hadron production phenomenology in high energy collisions.

Presenter: Prof. SONG, Jun (Jining University)

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

The 125th HENPIC seminar by Dr. Jiaxing Zhao 赵佳星 (Tsinghua U.), Oct. 22, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Heavy flavor hadrons in heavy-ion collisions

Speaker: Dr. Jiaxing Zhao (Tsinghua University)

Abstract: The property of running coupling constant makes the quark confined to hadrons in vacuum. A deconfined quark-gluon plasma(QGP) can be produced through the relativistic heavy-ion collisions. The formation of QGP has a profound influence on the production and structure of heavy flavor hadrons. In turn, heavy quarks or hadrons can be used to detect and study the hadronization mechanism of QGP and so on. First of all, we use two/ three-body Schroedinger equation and Dirac equation to study the static properties of heavy flavor hadron in vacuum and finite temperature. It is essential for studying the production and structure of these heavy flavor hadrons in the QGP. Then, we calculated the yield of multi-charmed baryons and fully-heavy tetraquark states in heavy-ion collisions via the coalescence model. We find that the yield of doubly charmed baryons and fully-heavy tetraquark states in heavy-ion collisions is much higher than that in p+p collisions, which provides an effective way to find these new particles in the experiments. In addition, we find that the internal structure of triply charmed baryon dependents on the temperature and triply charmed baryon can be Borromean state and Efimov state. Finally, I will give two examples of using heavy flavor hadrons to probe the hadronization mechanism and rotational properties.

Self-introduction: Jiaxing Zhao obtained Ph.D. under the supervision of Prof. Pengfei Zhuang from Tsinghua University in 2020, and currently a post-doctoral at Tsinghua University. His research focuses on few-body bound state at the quark level, in particular, the heavy flavor hadrons structure and production in heavy-ion collisions.

Presenter: Dr ZHAO, Jiaxing (Tsinghua University)

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

The 126th HENPIC seminar by Prof. Xiaohui Liu 刘晓辉 (Beijing Normal U.), Oct. 29, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Jets/event shapes for matter inner structures

Speaker: Prof. Xiaohui Liu, Beijing Normal University

Abstract: Jet and its many guises (event shapes, boosted hadrons, …) are important tools for revealing QCD dynamics at high energy colliders. Recently, there have been growing interests in probing nucleon/nuclei internal structures using jets. In this talk, I will briefly review the concept of the jets from a perturbative QCD perspective and compare the advantages of the jets and event shapes. I will present some recent theoretical developments in jets/event shapes relevant to EIC physics.

Self-introduction: Xiaohui Liu is currently an assistant Professor at Beijing Normal University and a junior scholar at the high energy physics center of Peking University. His main interest is to develop precision frameworks/predictions for collider phenomenologies out of the pQCD first principles.

Presenter: Prof. LIU, Xiaohui

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

The 127th HENPIC seminar by Dr. Haojie Xu 徐浩洁 (Huzhou U.), Nov. 12, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Probing the neutron skin with ultra-relativistic isobaric collisions

Speaker: Dr. Haojie Xu, Huzhou University

Abstract: Neutron structure and skin thickness in nuclei have been traditionally measured by low-energy scatterings where the nuclei are only gently disturbed. Their precisions have been limited by theoretical uncertainties in modeling the nuclear force. Here, we propose an unconventional approach to probe the neutron skin by smashing isobar nuclei completely apart at relativistic energies to compare their produced hadron multiplicities. Because particle production in relativistic heavy-ion collisions depends on the details of the nucleon density distributions in the colliding nuclei, we demonstrate that the small difference in hadron multiplicities between isobar collisions, together with state-of-the-art calculations of nuclear structure, can provide exquisite sensitivity to the poorly constrained neutron density distributions and skin thickness, which can in turn put stringent constraints on the nuclear symmetry energy.

Self-introduction: Haojie Xu, currently a research assistant at Huzhou University(湖州师范学院), obtained his Ph.D. under the supervision of Prof. Qun Wang from USTC in 2012. His research focuses on the phenomenological and experimental study of correlations and fluctuations in relativistic heavy-ion collisions.

Presenter: Dr XU, Haojie

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

The 128th HENPIC seminar by Prof. Yen-Jie Lee (MIT), Nov. 26, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Studies of Jet Quenching and the Induced Medium Excitation with the CMS detector

Speaker: Prof. Yen-Jie Lee, MIT

Abstract:

Quantum Chromodynamics (QCD) is a complete theory of strong interaction. However, generally, calculations with QCD are notoriously difficult. In particular, the phases of quark matter are poorly understood. Predicted by lattice QCD calculations, the Quark-Gluon Plasma can be created in relativistic heavy-ion collisions. This strongly interacting quantum liquid, first discovered at the Relativistic Heavy Ion Collider (RHIC), was found to flow more freely than any other known fluid with charged particle angular correlation analyses.

To go beyond the studies of the debris of the QGP, we can study the passage of color charged particles through this fascinating medium. One studies heavy-ion collisions which produce not only the QGP but also energetic gluons and quarks by chance. High energy quarks and gluons lose energy by radiating gluons or by colliding with the other quarks and gluons as they traverse through the QGP, a phenomenon often referred to as "Jet Quenching". The deceleration of the hard probes and the QGP medium response to them could be studied by the correlation between electroweak bosons, jets, and charged hadrons. These experimental observables are expected to be sensitive to the QGP thermodynamical and transport properties.

In this seminar talk, I will review the most striking observations made in data collected by the Compact Muon Solenoid detector at the Large Hadron Collider. I also plan to provide a more detailed discussion on the experimental method and the lessons learned from the recent large area jet measurements and Z-tagged inclusive hadron spectra.

Self-introduction:

Yen-Jie Lee, currently an associate professor at MIT since 2018. He joined MIT Department of Physics in 2013 after a fellowship at CERN and postdoc research at the Laboratory for Nuclear Science at MIT. His bachelor's and master's degrees were awarded by the National Taiwan University in 2002 and 2004, respectively, and his doctoral degree by MIT in 2011. Lee is an experimental particle physicist in the field of proton-proton and heavy-ion physics. He works on jets and heavy flavor particle production in nuclei collisions, and also pioneered studies of high-density QCD with electron-position annihilation data.

Presenter: Prof. LEE, Yen-Jie (MIT)

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

The 129th HENPIC seminar by Dr. Mauricio Martinez Guerrero (North Carolina State U.), Dec. 10, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Transasymptotics, dynamical systems and far from equilibrium fluid dynamics

Speaker: Dr. Mauricio Martinez Guerrero, North Carolina State U.

Abstract:
nbsp;nbsp;nbsp;Hydrodynamics is a physical theory which describes long wavelength phenomena. Any introductory physics textbook indicates that the applicability of hydrodynamics is restricted to be near to local thermal equilibrium. This assumption seems to be very restrictive given the overwhelming experimental evidence of fluid behavior seen in nucleus-nucleus collisions and cold atoms systems. The fact that hydrodynamics can be applied to these non-equilibrated physical systems calls for a better understanding of the foundations of hydrodynamics.
nbsp;nbsp;nbsp;In this talk I will discuss the most recent developments of the theory for in and out of equilibrium fluids. I shall present new theoretical results related to the emergence of hydrodynamic attracting behavior, non-hydrodynamic transport and its relation with transasymptotics and trasseries. I shall also introduce in a pedagogical manner a new set of mathematical tools used frequently to analyze dynamical systems in the context of hydrodynamics. I will conclude by discussing new possibilities for future research directions.

Self-introduction:
nbsp;nbsp;nbsp;Mauricio Martinez Guerrero, currently a research scholar at North Carolina State University. Previously he was postdoctoral researcher at Ohio State University, Universidade de Santiago de Compostela and the Institute for Advanced Studies in Frankfurt. He did his PhD in Frankfurt University. His research work focuses to understand the behavior of matter when it is subject at extreme conditions like high temperatures, pressures and/or densities. More specifically, his work has been related with the formulation of anisotropic hydrodynamics, studies of color decoherence in a QCD medium, development of new theoretical tools to analyze far-from-equilibrium dynamics.

Presenter: Dr MARTINEZ GUERRERO, Mauricio (North Carolina State U.)

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

The 130th HENPIC seminar by Dr. Xiao-Liang Xia 夏晓亮 (Fudan U.), Dec. 24, 2020, Thursday, 10:30 am (UTC+8)

Talk title: Spin polarization of hyperons and vector mesons in heavy-ion collisions

Speaker: Dr. Xiao-Liang Xia, Fudan University

Abstract:
The quark-gluon plasma (QGP) produced in heavy ion collisions has strong fluid vorticity. Such vorticity can lead to spin polarization of hyperons and spin alignment of vector mesons, which provide us an important tool to study the rotational properties of a QGP droplet. In this seminar, I will discuss some properties of the vorticity, through which we can understand the beam-energy dependence of the global Lambda polarization. Those properties also inspire us to further study the local Lambda polarization. However, some puzzles regarding the local Lambda polarization and the vector meson spin alignment still need to be resolved. I will talk about some theoretical efforts to resolve these puzzles, and finally present our new results about the vector meson spin alignment.

Self-introduction:
Xiao-Liang Xia obtained his Ph.D. under the supervision of Prof. Qun Wang from USTC in 2018, and is currently a post-doctor at Fudan University. His research focuses on vorticity, magnetic field, and spin polarization of hyperons and vector mesons in heavy-ion collisions.

Presenter: Dr XIA, Xiao-Liang (Fudan University)

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

The 131st HENPIC seminar by Dr. Haitao Li 李海涛 (Northwestern U & Argonne National Lab), Jan. 7, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Jets and Heavy Flavor at the Electron-Ion Collider

Speaker: Dr. Haitao Li, Northwestern U & Argonne National Lab

Abstract:
Theoretical investigations for observables are crucial to answer fundamental questions at the future electron-Ion Collider. In this talk, I will discuss our recent theoretical works in calculating cross-sections and substructure for jets and open heavy flavor in electron-nucleus collisions. For jet production, we demonstrate theoretically how to disentangle the effects from nuclear parton distribution functions and the ones that arise from strong final-state interactions between the jet and the nuclear medium. For open-heavy flavor hadron production, we show how to identify the optimal observables, center-of-mass energies, and kinematic regions most sensitive to the physics of energy loss and hadronization at the EIC.

Self-introduction:
Haitao Li, currently a postdoc research scholar at Northwestern University and Argonne National Laboratory. Previously he worked as postdoctoral researcher at Los Alamos National Laboratory and Monash University. He got his PhD in Peking University. His research work focuses on perturbative QCD and collider physics, such as fixed-order QCD corrections and resummation. He also works on jet physics in heavy-ion and electron-ion collisions.

Presenter: Dr LI, Haitao (Northwestern U & Argonne National Lab)

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

The 132nd HENPIC seminar by Dr. Zilong Chang 常子龙 (Brookhaven National Lab), Jan. 21, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Spin Physics at the STAR experiment

Speaker: Dr. Zilong Chang, Brookhaven National Lab

Abstract:
The proton structure has been studied extensively over the past a few decades, especially from the polarized Deep Inelastic Scattering (DIS) Experiments. However due to its limit coverage in $-^2$ phase space and inability to directly access gluon inside the proton, at Relativistic Heavy Ion Collider (RHIC), the world-only polarized proton collider, it provides excellent opportunities to study the internal structure of proton. At both √=200 and 510 GeV, the Solenoidal Tracker at RHIC (STAR) experiment has carried out a series of measurements from both longitudinally and transversely polarized collisions. The longitudinal double spin asymmetry, from inclusive jet and dijet production at √=200 GeV provided the first evidence of the positive gluon polarization for >0.05. At √=510 GeV, the same measurements have pushed the gluon polarization down to ~0.02. The longitudinal single-spin asymmetry from $^{\pm}$ boson at √=510 GeV shows that -flavor sea quark polarization, , is larger than the -flavor sea quark polarization, . The transverse single-spin dependence of the azimuthal asymmetry of charged pions in a jet indicated the first evidence of transversity in the collisions. The results enable to test the universality and factorization-breaking effects in collisions for Transverse-Momentum Dependent (TMD) distributions. In this talk, I will present the published and current measurements from STAR that explore both the helicity distribution functions and transverse structure of the proton.

Self-introduction:
Zilong Chang got his B.S. in Physics from University of Science and Technology of China in 2010, and his Ph.D in Physics from Texas A&M University in 2016. Since 2017, he has been working at Brookhaven National Laboratory as a post-doc researcher. His doctoral dissertation is on measurements of longitudinal double-spin asymmetry for inclusive jet production from √ = 510 GeV polarized collisions at STAR. Currently he is working with the same dataset to extract the inclusive jet cross-section to explore the gluon parton distribution function inside the proton.

Presenter: Dr CHANG, Zilong (Brookhaven National Laboratory)

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

The 133rd HENPIC seminar by Yuuka Kanakubo (Sophia University), Jan. 28, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Dynamical core–corona picture from small to large colliding systems

Speaker: Yuuka Kanakubo, Sophia University

Abstract:
A possibility of quark-gluon plasma (QGP) formation in small colliding systems is implied by various experimental data. Focusing on one of the experimental data, strangeness-enhancement, we investigate this possibility through the dynamical core–corona initialization (DCCI) model.

The core–corona is a two-component picture proposed to study multiplicity/centrality dependence of final hadron yield ratios. Conventionally high-density regions in which the thermalized matter is generated are referred to as core, and low-density regions in which no such thermalization occurs are referred to as corona. Introducing the core–corona picture into the dynamical initialization framework, we demonstrate a dynamical separation of core and corona. In our framework, QGP fluids are generated by traversing partons produced at an initial stage of a nuclear collision. At the end of dynamical separation, the generated medium becomes an initial condition of hydrodynamics (core) and surviving partons (corona) undergo string fragmentation.

In this seminar, I give an overview of concepts and detailed modeling of the DCCI and show results of particle yield ratios as a function of multiplicity in p-p, p-Pb and Pb-Pb collisions. I report there is a possibility of partial QGP formation even in p-p collisions with $_{\mathrm{ch}}/ \sim 10$.

Self-introduction:
Yuuka Kanakubo, Ph.D. student at Sophia University in Tokyo, Japan. Master’s degree at Sophia University in 2019 under Prof. Tetsufumi Hirano. Awarded “Nuclear Physics A Elsevier Young Scientist Awards” at Quark Matter 2019. One of the main interests is to develop a unified framework to investigate various observables from small to large colliding systems.

Presenter: Ms KANAKUBO, Yuuka (Sophia University)

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

The 134th HENPIC seminar by Yuan-Sheng Zhao 赵渊晟 (Fudan University), Feb. 24, 2021, Wednesday, 10:30 am (UTC+8)

Talk title: Deep-learning-assisted chiral magnetic effect search in heavy-ion collisions

Speaker: Yuan-Sheng Zhao, Fudan University

Abstract:
Although multiple observables are proposed, the search of chiral magnetic effect (CME) in heavy-ion collisions suffers difficulties because of the large background effects. Instead of proposing new observables, we employ the deep learning method to assist the CME search from data, which is simulated using a multiphase transition model. A modified convolutional neural network (CNN) is properly trained to identify the typical pattern of CME in the final hadronic distributions. Such pattern is robust against collision energy, centrality, and also what is thought to be the most relevant background, the elliptic flow. Tests for isobaric collisions on the deep learning method shows nice transportability to other collision systems.

Self-introduction:
Yuan-Sheng Zhao, currently studying as a PhD student at Fudan University, where he also got his B.S. He works on physics of heavy-ion collisions. Recently he is focusing on the application of deep-learning method to the heavy-ion collision (HIC) system.

Presenter: Mr ZHAO, Yuan-Sheng (Fudan University)

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

The 135th HENPIC seminar by Dr. Fei Gao 高飞 (Heidelberg University), Mar. 10, 2021, Wednesday, 13:30 (UTC+8)

Talk title: QCD phase structure in functional QCD method

Speaker: Dr. Fei Gao, Heidelberg University

Abstract:
QCD can be characterized by its running behavior. It shows asymptotic behavior in ultraviolet and dynamical mass generation in infrared. This feature gives QCD a rich phase structure at finite temperature and chemical potential. A functional QCD method which combines Dyson-Schwinger equations with function renormalization group method, has been recently proposed. Within this scheme, the QCD phase structure can be obtained without any modelling parameters needed, and the critical end point is then firstly predicted at (T, μ_B) = (110, 600) MeV. Here I would like to explain and analyze in detail, how to apply the functional QCD method for computing phase structure, and furthermore, the related thermal states of QCD are also analyzed.

Self-introduction:
Fei Gao was a PhD student in PKU supervised by Prof. Yuxin Liu, and then stayed in the group for 2 more years as a postdoc. He then went to Valencia University and collaborated with Prof. Joannis Papavassiliou. He is currently in Heidelberg University in collaboration with Prof. Jan M. Pawlowski as a Humboldt fellow. His research is mainly to study QCD phase structure in functional QCD method.

Presenter: Dr GAO, Fei (Heidelberg University)

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

The 136th HENPIC seminar by Dr. Wei Chen 陈蔚 (University of Chinese Academy of Sciences), Mar. 24, 2021, Wednesday, 10:30 (UTC+8)

Talk title: Search for the elusive jet-induced diffusion wake with 2D jet tomography

Speaker: Dr. Wei Chen, University of Chinese Academy of Sciences

Abstract:
Diffusion wake is an unambiguous part of the jet-induced medium response in high-energy heavy ion collisions that leads to a depletion of soft hadrons in the opposite direction of the jet propagation. In this talk, new experimental data on Z-hadron correlation in Pb+Pb collisions at the Large Hadron Collider show, however, an enhancement of soft hadrons in the direction of both the Z and the jet. We use a coupled linear Boltzmann transport and hydro model to demonstrate that medium modification of partons from the initial multiple parton interaction (MPI) gives rise to a soft hadron enhancement that is uniform in azimuthal angle while jet-induced medium response and soft gluon radiation dominate the enhancement in the jet direction. After subtraction of the contributions from MPI with a mixed-event procedure, the diffusion wake becomes visible in the near-side Z-hadron correlation. We further employ the longitudinal and transverse gradient jet tomography for the first time to localize the initial jet production positions in Z/γ-jet events in which the effect of the diffusion wake is apparent in Z/γ-hadron correlation even without the subtraction of MPI.

Self-introduction:
Wei Chen was a PhD student in CCNU supervised by Prof. Xin-Nian Wang. He is currently in University of Chinese Academy of Sciences in collaboration with Prof. Mei Huang as a postdoc. His research is mainly to study jet-medium interaction, including jet-induced medium excitation in heavy-ion collisions with phenomenological model.

Presenter: Dr CHEN, Wei

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

The 137th HENPIC seminar by Prof. Xiaofeng Luo 罗晓峰 (Central China Normal University), Apr. 7, 2021, Wednesday, 10:30 (UTC+8)

Talk title: QCD critical point and net-proton number fluctuations

Speaker: Prof. Xiaofeng Luo, CCNU

Abstract:
Understanding the properties of quark matter and its phase structure can enhance our knowledge of universe evolution and the structure of visible matters. In the last two decades, many experimental evidences for the strongly interacting quark-gluon plasma (sQGP) have been observed in high energy heavy-ion collisions. Therefore, exploring the QCD phase structure at high baryon density, such as mapping the 1st order phase boundary and finding the QCD critical point, becomes one of the most important goals of the heavy-ion collisions. During 2010-2017, RHIC has finished the first phase of Beam Energy Scan program (BES-I), and STAR experiment has collected the data of Au+Au collisions at various collision energies from 200 to 7.7 GeV. To confirm the intriguing observations at BES-I, RHIC has started the second phase of beam energy scan program (BES-II) since 2018, focusing on the energies below 27 GeV. From 2018 to 2020, STAR experiment has taken the data of high statistics Au+Au collision at 9.2, 11.5, 14.6, 19.6 and 27 GeV (collider mode) and 3.0 - 7.7 GeV (fixed target mode). In this talk, I will discuss the recent experimental progress for exploring the QCD phase structure at RHIC-STAR experiment, especially focusing on the QCD critical point search. New facilities aiming for high baryon density region and future plan will be also discussed.

Self-introduction:
罗晓峰，华中师范大学粒子物理研究所教授、博士生导师。
本科 (2006)、博士 (2011) 毕业于中国科学技术大学近代物理系。2009-2011 年在美国劳伦斯伯克利国家实验室联合培养。毕业后作为师资博后加入华中师大并留校任教至今。先后在日本筑波大学、加州大学洛杉矶分校做访问学者。参与美国 STAR 以及德国 CBM 实验, 近 10 年来，致力于高能重离子碰撞中 QCD 相变临界点的实验研究，取得一批创新性和原创性的研究成果。首次观测到净质子数涨落对碰撞能量的非单调依赖, 为进一步确认 QCD 临界点位置、研究 QCD 相结构提供重要实验依据。系统研究了非临界效应对守恒荷涨落的影响，为寻找临界点提供参考基线。2018 年获首届美国布鲁克海文国家实验室 Merit Award。2012 年“晨光杯”中国高能物理学会青年优秀论文一等奖。现为 STAR 实验涨落与关联分析组召集人, CBM 实验理事成员。

Presenter: Prof. LUO, Xiaofeng

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

The 138th HENPIC seminar by Prof. Jianhua Gao 高建华 (Shandong University, Weihai), Apr. 22, 2021, Thursday, 10:30 (UTC+8)

Talk title: Second order non-dissipative currents in a chiral system

Speaker: Prof. Jianhua Gao, Shandong University (Weihai)

Abstract:
In this talk, I will mainly present the second order non-dissipative transport coefficients derived from the Wigner equation for massless spin-1/2 charged fermions in global equilibrium. The Wigner equation can be solved order by order in the power expansion of the vorticity and electromagnetic field. The Wigner function is derived up to the second order from which the non-dissipative charge currents and the stress tensor can be obtained. At second order, the vector and axial Hall currents can be induced along the direction orthogonal to the vorticity and electromagnetic field and the charge and energy densities and the pressure have contributions from the vorticity and electromagnetic field as well. We also demonstrate that the solution in global equilibrium is fully constrained at the first order while some terms associated with vorticity at second order can only be determined up to some unknown functions. Besides, I will also discuss the trace anomaly of the energy-momentum tensor.

Self-introduction:
Jianhua Gao is currently a professor at Shandong University (Weihai). He obtained the PhD degree in Shandong University (Jinan) in 2008, then worked as a postdoc in USTC for two years. He joined Shandong University (Weihai) as an associate professor in 2011. His current research interests are quantum kinetic theory and chiral & spin effects in relativistic heavy-ion collisions.

Presenter: Prof. GAO, Jianhua

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

The 139th HENPIC seminar by Prof. Dingyu Shao 邵鼎煜 (Fudan University), May 6, 2021, Thursday, 10:30 (UTC+8)

Talk title: Jets and flavor content of nucleons

Speaker: Prof. Dingyu Shao, Fudan University

Abstract:
The theoretical description of jet observables is at the heart of the high-energy collisions. Recently various studies have demonstrated that jets can be useful tools for probing nucleon 3D structures, and the potential of jet physics at the future EIC is a fast emerging field of research. The advent of the ElC with its high luminosity and polarized beams will unlock the full potential of jets. Since jets are made of collimated bunches of hadrons, their substructures would provide more information to access nucleon inner structures. In this talk, I will review some recent works relevant to the EIC jet physics, including flavor and charge tagged jet production and recoil-free tracking jet definitions.

Self-introduction:
Dingyu Shao is currently a junior professor at Fudan University and an associate member of Theory Department at CERN. Before joining Fudan University in 2021, he has worked at UCLA, CERN, and University of Bern. His main research focuses on quantum field theory and its application, particularly QCD at high energy colliders, including 1. QCD effective field theory 2. Infrared structure of non-abelian gauge theories and QCD factorization theorem 3. Collider phenomenology: jet and heavy flavor physics 4. Spin physics and quantum tomography of nucleons.

Presenter: Prof. SHAO, Dingyu

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

The 140th HENPIC seminar by Prof. Francesco Becattini (University of Florence), May 12, 2021, Wednesday, 14:00 (UTC+8)

Talk title: New developments of spin physics in relativistic heavy ion collisions

Speaker: Prof. Francesco Becattini, University of Florence

Abstract:
Spin is a relatively new topic in the rather mature field of relativistic heavy ion collisions and it has attracted much interest over the past few years. The predictions of the hydrodynamic model of the Quark Gluon Plasma, providing the proportionality between spin polarization vector and thermal vorticity, have been confirmed by the measurements of global spin polarization of Lambda hyperons in peripheral collisions. However, the measurements of spin polarization as a function of the hyperon momentum revealed consistent discrepancies with respect to the theoretical predictions. In this talk, I will present a recent theoretical development which apparently implies a solution of the local polarization puzzles. The covariant theory of quantum relativistic fluids at local equilibrium indeed predicts an additional term, hitherto overlooked, of the spin polarization vector which is proportional to the shear tensor. This additional contribution is able to reconcile the theory with the experimental data if the Quark Gluon Plasma hadronizes at a fixed temperature.

About the speaker:
Francesco Becattini is currently a full professor at the University of Florence (Italy) and an associate member of the Italian National Institute of Nuclear Physics. He studied in Florence, Pisa and CERN and got his PhD at the University of Florence in 1996. He is a member of the European science academy “Academia Europaea”. His main research interests are in relativistic heavy ion physics, relativistic statistical mechanics, statistical field theory.

Presenter: Prof. BECATTINI, Francesco

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

The 141st HENPIC seminar by Baochi Fu 付宝迟 (Peking University), June 2, 2021, Wednesday, 10:30 am (UTC+8)

Talk title: Global and local spin polarization in heavy-ion collisions

Speaker: Baochi Fu, Peking University

Abstract:
In non-central heavy-ion collisions, the produced quark-gluon plasma (QGP) carries a large amount of orbital angular momentum, which couples with the spin of constituent particles and finally induce spin polarization of emitted hyperons. The observed Lambda spin polarization at RHIC and LHC experiments provides new insights into the properties of hot and dense QCD matter. Theoretically, one widely studied effect is the spin polarization induced by thermal vorticity. Such calculation successfully predicts the global polarization in experiments but fails to describe its azimuthal angle dependence.
In this talk, I will firstly review the hydrodynamic/transport model calculation based on thermal vorticity and then focus on the local polarization puzzle. In additional to thermal vorticity effects, recently we identify an undiscovered contribution from shear stress tensor, which can be obtained by quantum kinetics and linear response theory. By using realistic hydrodynamic calculations, we find the shear contribution always shows the same azimuthal angle dependence as observed in experiments and competes with thermal vorticity effects. In the scenario that Lambda inherits and memorizes the spin polarization of strange quark, shear contribution wins the competition and the local polarization agrees qualitatively with the experiment measurements.

About the speaker:
Baochi Fu, currently a Ph.D. candidate in Peking University supervised by Prof. Huichao Song. His research focuses on collective flow and spin polarization in relativistic heavy-ion collisions.

Presenter: Mr FU, Baochi

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

The 142nd HENPIC seminar by Prof. Wangmei Zha 查王妹 (University of Science and Technology of China), June 16, 2021, Wednesday, 10:30 am (UTC+8)

Talk title: Coherent Photoproduction in Relativistic Heavy-ion Collisions

Speaker: Prof. Wangmei Zha, USTC

Abstract:
The coherent photon-nucleus and photon-photon interactions has been studied in detail at RHIC and LHC to probe the gluon distribution in nucleus and to test QED via relativistic heavy-ion collisions. These kind of interactions are traditionally thought to only exist in ultra-peripheral collisions, where there is no hadronic interactions. Recently, a significant excess of J/ψ yield and dielectron production at very low transverse momentum (pT < 0.3 GeV/c) was observed by the ALICE and STAR collaborations in peripheral A+A collisions, which points to evidence of coherent photoproduction in violent hadronic interactions. The survival of photoproduced J/ψ and electron pair in hadronic heavy-ion collisions merits experimental and theoretical investigations, which are currently rare on the market. Furthermore, the additional source from coherent photoproduction could serve as a novel probe to study the properties of quark-gluon plasma. In this presentation, I will report our recent studies on coherent photoproduction in relativistic heavy-ion collisions and discuss the feasibility of exploring the properties of quark-gluon plasma with the coherent photon induced products.

About the speaker:
Wangmei Zha is currently an associate professor at USTC. His research interest lies in the data analysis and phenomenological models about coherent photoproduction in relativistic heavy-ion collisions and in the future EIC. He joined STAR collaboration since 2012 and led the coherent J/ψ measurements in STAR. He served as the convener of STAR light flavor physics working group during 2018 and 2020, and won the RHIC&AGS merit award in 2019.

Presenter: Prof. ZHA, Wangmei

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

The 143rd HENPIC seminar by Prof. Hua Xing Zhu 朱华星 (Zhejiang University), July 1, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Probing Gluon Spin Correlation with Jet Substructure

Speaker: Prof. HuaXing Zhu, Zhejiang University

Abstract:
The study of spin effects in QCD has a long history. Precision jet substructure opens new doors for studying these effects. To achieve this goal, one hopes to find a spin-sensitive observable that is also theoretically accessible to perturbative calculation and resummation, which is in general not an easy task.

In this talk, I will show that spin effects are encoded in the shape dependence of three-point correlator within a jet. In a particular kinematic limit, called the squeezed limit, one can see a sinusoidal pattern in the angular distribution of energy, which is the result of the interference of the spins of gluons in the jet. All orders resummation in this limit is governed by the twist-2 transverse spin-2 gluon operator. In the second part of the talk, I will show how Lorentz symmetry helps to re-organize the three-point correlator into partial wave, which resums higher-spin angular correlation and provides insight into splitting processes beyond leading power.

About the speaker:
HuaXing Zhu is a junior faculty member at Zhejiang University. He obtained his PhD from Peking University in 2012, after which he spent 5 years as a postdoc at SLAC and MIT. He is mainly interested in quantum field theory and its application to high energy colliders. He has published 60 papers, including 10 in Physical Review Letters. He is the recipient of 2020 Qiushi young scholar award by Qiushi Science and Technologies Foundation.

Presenter: Prof. ZHU, Hua Xing

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

The 144th HENPIC seminar by Dr. Ziyue Wang 王梓岳 (Tsinghua University), July 15, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Damping and polarization rates in near equilibrium spin transport

Speaker: Dr. Ziyue Wang, Tsinghua University

Abstract:
The collision terms in spin transport theory are analyzed in Kadanoff-Baym formalism for systems close to equilibrium. The non-equilibrium fluctuations in spin distribution include both damping and polarization, with the latter arising from the exchange between orbital and spin angular momenta. The damping and polarization rates or the relaxation times are expressed in terms of various Dirac components of the self-energy. Unlike the usually used Anderson-Witting relaxation time approximation assuming a single time scale for different degrees of freedom, the polarization effect is induced by the thermal vorticity and its time scale of thermalization is different from the damping. The numerical calculation in the Nambu–Jona-Lasinio model shows that, charge is thermalized earlier and spin is thermalized later.

About the speaker:
Ziyue Wang got her PhD in Tsinghua University in 2019, now continues her research in Tsinghua University as a PostDoc. Her research interests include QCD phase transition and transport phenomenon.

Presenter: Dr WANG, Ziyue

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

The 145th HENPIC seminar by Prof. Fuqiang Wang 王福强 (Purdue U. & Huzhou U.), August 12, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Experimental Status of the Chiral Magnetic Effect

Speaker: Prof. Fuqiang Wang, Purdue U. & Huzhou U.

Abstract:
The chiral magnetic effect (CME) has excited immense interest because of its fundamental physics of topological gluon field in QCD and possible connection to the matter-antimatter asymmetry of the universe. It refers to a charge separation arising from the chiral anomaly under the influence of a strong magnetic field. Experimental measurements of CME-sensitive charge separation observables in heavy ion collisions are overwhelmed by physics backgrounds. The experimental challenge has become how to control/calibrate the backgrounds in order to extract the possible small CME signal. In this seminar, I will first give a brief introduction of the CME and the background issue in its experimental search with a limited survey of the experimental observables. I will then focus on the most recent measurement from STAR utilizing the spectator and participant planes in Au+Au collisions 1, especially regarding possible additional backgrounds [2]. Finally I will discuss some trivial effects pertinent to the isobar collisions [3], and outlook the prospects of future Au+Au data taking at RHIC.

1 STAR Collaboration, "Search for the chiral magnetic effect via charge-dependent azimuthal correlations relative to spectator and participant planes in Au+Au collisions at 200 GeV", arXiv:2106.09243 [nucl-ex].
[2] Yicheng Feng et al., "Two- and three-particle nonflow contributions to the chiral magnetic effect measurement by spectator and participant planes in relativistic heavy ion collisions", arXiv:2106.15595 [nucl-ex].
[3] Yicheng Feng et al., "Revisit the Chiral Magnetic Effect Expectation in Isobaric Collisions at the Relativistic Heavy Ion Collider" , arXiv:2103.10378 [nucl-ex], Phys. Lett. B 820 (2021) 136549.

About the speaker:
Fuqiang Wang is a professor of physics at Purdue University and Huzhou University. He is a high energy nuclear experimentalist, and a member of the RHIC-STAR, CERN-CMS, and NICA-MPD Collaborations. He worked on many areas of research in heavy ion physics; his latest interest is in experimental search for the chiral magnetic effect predicted by quantum chromodynamics. He received his Ph.D. from Columbia University in 1996 with work on heavy ion experiments at BNL, and worked as a postdoctoral fellow at LBNL before joining the Purdue faculty.

Presenter: Prof. WANG, Fuqiang

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

The 146th HENPIC seminar by Prof. Ang Li 李昂 (Xiamen University), August 26, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Constraints on the maximum mass of neutron stars with strangeness

Speaker: Prof. Ang Li, Xiamen University

Abstract:
The study of neutron star equation of state (EOS) has entered a quantitative age, with a growing body of robust data to clarify the basic facts of these mysterious objects. Constraints on EOS mainly come from theoretical many-body calculations, laboratory measurements of nuclear properties & reactions, and observations in astronomy. The golden event of GW170817 from LIGO/Virgo has brought the best time of the multi-messenger era for dense matter EOS. Especially, the NICER mission has simultaneously estimated the mass and radius of two pulsars (PSR J0030+0451 and 0740+6620). I will introduce our recent works on constraining the EOS and the maximum mass of neutrons stars with strangeness (2006.00839, 2009.12571, 2103.15119, 2107.13997, 2107.07979) by connecting consistently nuclear experiments and GW+EM observations of neutron stars.

About the speaker:
Ang Li is currently a professor in the Department of Astronomy, Xiamen University (https://astro.xmu.edu.cn/info/1071/211
She has worked as visiting scholar in INFN-LNS and University of Catania, Italy and Texas A&M University-Commerce and University of Nevada Las Vegas, USA. From 2012 to 2013, she served as a Foreign Postdoctoral Researcher at RIKEN, Japan. She is engaged in research on the neutron star equation of state on a microscopic basis, and her work has been cited 1000+ times by, e.g., the LIGO/Virgo, NICER collaborations and KAGRA, STROBE-X white papers. Recently, she won the Top Cited Author Award (China) by the American Astronomical Society and IOP Publishing in 2020.

Presenter: Prof. LI, Ang

Contribution ID: **76** Type: **not specified**

The 147th HENPIC seminar by Prof. Jiangyong Jia (Stony Brook U. and Brookhaven National Lab.), September 9, 2021, Thursday, 10:30 am (UTC+8)

Talk title: New opportunities to probe nuclear deformation using high-energy heavy-ion collisions

Abstract: High-energy heavy-ion collisions, a branch of nuclear physics that focus on study of quark-gluon plasma (QGP) and nuclear phase diagram, have always assumed an initial condition from the nuclear structure physics, e.g. the Woods-Saxon geometry. Recent progress in hydrodynamic modeling together with the wealth of precision collective flow data, however, allow us to not only perform quantitative extractions of the transportproperties of the QGP, but very importantly start to strongly constrain the initial state of the colliding nuclei. In this talk, I will discuss the exciting possibility of imaging the shape of atomic nuclei using precision flow measurements, including the quadruple, tri-axial and octupole deformations. I will discuss how the shape information probed by heavy ion collision might be different or complementary to those obtained in the nuclear structure experiments. I will argue how a carefully planned system scan of stable species in the nuclear chart at RHIC and other facilities could open new direction of research innuclear physics.
1 “Shape of atomic nuclei in heavy ion collisions”, arXiv:2106.08768
[2] “Constraining nuclear quadrupole deformation from correlation of elliptic flow and transverse momentum in nuclear collisions”, arXiv:2105.05713
[3] “The impact of nuclear deformation on relativistic heavy-ion collisions: assessing consistency in nuclear physics across energy scales”, arXiv:2105.01638

About the speaker: Jiangyong Jia is a full professor in Stony Brook University (SBU) and senior physicist in Brookhaven National Laboratory (BNL). He is member of RHIC-STAR and LHC-ATLAS, and previously the RHIC-PHENIX experiments, with broad interests in high energy nuclear physics and particle physics. However, his main expertise is in the area of collective flow, hydrodynamics and particle correlations from small to large collision systems. He received his B.S. degree from USTC in 1997, Ph.D. from SBU in 2003, worked as a postdoc in Columbia University, before joining the faculty at SBU and BNL in 2006.

Primary author: Prof. JIA, Jiangyong (Stony Brook U. and Brookhaven National Lab.)

Presenter: Prof. JIA, Jiangyong

Contribution ID: **77** Type: **not specified**

The 148th HENPIC seminar by Dr. Prithwish Tribedy (Brookhaven National Lab.), September 16, 2021, Thursday, 10:30 am (UTC+8)

Talk title: Blind analysis of isobar data and search for the Chiral Magnetic Effect by the STAR Collaboration

Abstract: Relativistic heavy ion collisions (HICs) at the modern accelerators like the Relativistic Heavy Ion Collider and the Large Hadron Collider provide unique testing ground for the Quantum Chromodynamics (QCD) at high energies. The early stages of such collisions generate highest densities allowed by QCD and eventually leads to the formation of a liquid-like quark-gluon matter that filled the microsecond-old universe. Interestingly, the early stages of HICs also generate the strongest known electromagnetic fields (1018 Gauss) in the universe. The quantum fluctuations in the early stages of such collisions amidst such strong fields can lead to violation of local P and CP symmetries of strong interaction. As a consequence of such extreme conditions one expects to observe novel phenomena such as the Chiral Magnetic Effect (CME). Previous measurements of the CME remain inconclusive because of large background contributions. In order to better control the influence of signal and backgrounds, the STAR collaboration has recently performed a blind analysis on a large data sample of approximately 3.8 billion isobar Ru+Ru and Zr+Zr collisions at √sNN=200 GeV at the Relativistic Heavy Ion Collider. In this seminar I will discuss the findings and conclusions from the isobar blind analysis.

1 M. Abdallah et al. (STAR Collaboration), (2021), arXiv:2109.00131 [nucl-ex]

About the speaker: Prithwish Tribedy is an Associate Physicist at the Department of Physics at the Brookhaven National Laboratory. His research interests lie in the field of relativistic heavy ion collisions with a specific focus on the study of the QCD matter at the high-gluon density, initial state physics and the Chiral Magnetic Effect. He is currently an active member of the STAR experiment at the Relativistic Heavy Ion Collider. He received his Ph.D. degree from the Homi Bhabha National Institute, India in 2015, he then worked as a postdoc at the Brookhaven National Laboratory before becoming a scientist in 2019.

Contribution ID: **78** Type: **not specified**

The 149th HENPIC seminar by Dr. Xiaojian Du (Bielefeld University), Sep. 23, 2021, Thursday, 2:00pm (Beijing time)

Talk title: Pre-equilibrium QCD plasma in heavy-ion collisions

Abstract: Non-equilibrium systems are omnipresent in nature. QCD plasma out of equilibrium and its equilibration are of particular interest giving that the relativistic heavy-ion collisions (HICs) produce the non-equilibrium quark-gluon plasma (QGP) which eventually emerges to thermal hydrodynamic states. We investigate the kinetic and chemical equilibration of weakly coupled QCD plasma at finite density with a numerical implementation of QCD effective kinetic theory based on leading-order QCD, revealing the relevant equilibration pattern and turbulent nature of the QCD plasma far from equilibrium. We then show the QGP equilibration in HICs as a universal attractor towards hydrodynamics. Based on that, some phenomenological applications of the attractor in HICs are discussed.

1 X. Du, S. Schlichting, Phys. Rev. Lett. 127, 122301 (2021) arXiv:2012.09068

[2] X. Du, S. Schlichting, Phys. Rev. D 104, 054011 (2021) arXiv:2012.09079

[3] M. Coquet, X. Du, JY Ollitrault, S. Schlichting, M. Winn, Phys. Lett. B 821 (2021) 136626, arXiv:2104.07622

About the speaker: Xiaojian Du is a postdoc researcher at Bielefeld University. He works on theoretical study and numerical simulation of non-equilibrium quark-gluon plasma and its application in heavy-ion collisions. Before that, he obtained his Ph.D. from Texas A&M University working on quarkonium production from kinetic theory simulation and its phenomenology in heavy-ion collisions.

Contribution ID: **79** Type: **not specified**

The 150 HENPIC seminar by Shuzhe Shi, Stony Brook University and McGill University, October 8, 2021, Friday, 10:30am (Beijing time)

Title: Reconstruction of heavy-quark potential from Bottomonium spectrum using DNN

Abstract: Bottomonium states are key probes for experimental studies of the quark-gluon plasma (QGP) created in high-energy nuclear collisions. Theoretical models of bottomonium productions in high-energy nuclear collisions rely on the in-medium interactions between the bottom and antibottom quarks. The latter can be characterized by the temperature (T) dependent potential, with real (VR(T,r)) and imaginary (VI(T,r)) parts, as a function of the spatial separation (r). Recently, the masses and thermal widths of up to 3S and 2P bottomonium states in QGP were calculated using lattice quantum chromodynamics (LQCD). Starting from these LQCD results and through a novel application of deep neural network (DNN), here, we obtain VR(T,r) and VI(T,r) in a model-independent fashion. The temperature dependence of VR(T,r) was found to be very mild between T□0-330 MeV. For T=150-330 MeV, VI(T,r) shows rapid increase with T and r, which is much larger than the perturbation theory based expectations.

1 S. Shi, K. Zhou, J. Zhao, S. Mukherjee, P. Zhuang, arXiv:2105.07862.

About the speaker: Shuzhe Shi is currently a PostDoc at Stony Brook University. He obtained his master degree from Tsinghua University, under the supervision of Prof. Pengfei Zhuang, and received the PhD from Indiana University, Bloomington, supervised by Prof. Jinfeng Liao. Before the current position, he was a postdoc at McGill University and worked with Profs. Charles Gale and Sangyong Jeon.

Contribution ID: **80** Type: **not specified**

The 151th HENPIC seminar by Prof. Jinlong Zhang, Shandong University, Oct. 21, 2021, Thursday, 10:30 am (Beijing time)

Title: Probing neutron skin thickness with parity-violating electron scattering

Abstract: The difference of the root-mean-square radii of neutron and proton distributions inside nucleus is referred to as "neutron skin" which is of fundamental importance in nuclear physics and relativistic heavy-ion collisions. Neutron skin thickness is sensitive to the density dependence of symmetry energy which is a key parameter of nuclear matter Equation of State. Due to its significantly larger weak charge, neutron distribution can be cleanly and model-independently probed via the parity-violating electron scattering. The PREX-II/CREX experiments at Jefferson Lab have performed high precision measurements of neutron skin thickness of ^{208}Pb and ^{48}Ca. In this seminar, the experimental setup, data analysis, and results of PREX-II/CREX experiment will be presented.
1 D. Adhikari et al., (PREX Col.) PRL 126, 172502 (2021)

About the speaker: Jinlong Zhang is a professor at Shandong University (SDU). He is member of RHIC-STAR, JLab-PREX/CREX, and EIC-ATHENIA collaborations. His research interest is in the experimental studies of nuclear and nucleon structure and the spin effects therein. He received his Ph.D. in 2016 from SDU with work on RHIC-spin physics, and worked as postdoc at LBNL and Stony Brook University before joining faculty of SDU in 2020.

Contribution ID: **81** Type: **not specified**

The 152th HENPIC seminar by Dr. Kai Zhou, FIAS, Nov. 4, 2021, Thursday, 10:30am (Beijing time)

Title: Deeping Learning for Inverse Problems in High Energy Nuclear Physics

Abstract: Inverse Problems occur in almost all research areas, especially in the context of basic research for the exploration of matter related to high energy nuclear physics. Due to the indirect noisy observation or even 'ill-posedness', it's usually challenging to handle the inverse problem. In this talk I will introduce some of my recent projects that utilizing deep learning techniques for solving inverse problems in high energy nuclear physics. Specifically I will talk about on-line centrality-reconstruction for CBM experiment, from bottomonium mass and width information to heavy-quark potential, reconstruction of spectral function, and learning Neutron Star Equation of State from observatory.

About the speaker: Dr. Kai Zhou received his B.Sc. degree in Physics from Xi'an Jiaotong University in 2009 and his PhD degree in Physics from Tsinghua University with "Wu You Xun" Honors in 2014 (Superviser: Prof. Pengfei Zhuang). Afterwards he did his Postdoctoral research at Goethe University Frankfurt in the Institute for Theoretical Physics (ITP) . Since 2017, he joined FIAS as Research Fellow and lead the group "Deepthinkers" focusing on Deep Learning (DL) for physics and beyond, and since 2021 he became fellow at FIAS. Dr. Zhou has a very broad interest in physics and AI/DL application in different fields, particularly developing data-driven and physics-informed deep learning methods to help physics research.

Contribution ID: **82** Type: **not specified**

The 153th HENPIC seminar by Dr. Shuai Yang (SCNU), on Nov. 25, Thursday, 10:30 am, beijing time, 2021

Title: Converting light into matter: using the Breit-Wheeler process to probe QGP medium

Abstract:The Lorentz boosted electromagnetic fields shrouding relativistic heavy ions can be treated as a flux of linearly polarized quasi-real photons. The Breit-Wheeler process is the simplest process in quantum electrodynamics for converting light quanta into a matter lepton and its anti-matter counterpart. Recently, there has been intense interest in investigating the Breit-Wheeler process and its possible application to study the quark-gluon plasma (QGP). In this talk, I will firstly introduce the current achievements of the Breit-Wheeler process based on experimental results in ultra-peripheral heavy-ion collisions with the STAR experiment at the RHIC and the CMS experiment at the LHC. Then I will extend the Breit-Wheeler pair production to hadronic collisions and discuss the possibility of using the Breit-Wheeler process to probe the electromagnetic properties of QGP medium.
1 CMS, PRL 127 (2021) 122001
[2] STAR, PRL 127 (2021) 052302
[3] STAR, PRL 121 (2018) 132301

About the speaker: Shuai Yang is currently a professor in South China Normal University (SCNU). His research interests are exploring the photon-induced physics and QGP properties by using dilepton and quarkonium with the RHIC-STAR and LHC-CMS experiments. He received his B.S. degree and Ph.D from USTC in 2010 and 2016, respectively. Afterwards he worked as a postdoc at Brookhaven National Laboratory and Rice University before joining SCNU.

Contribution ID: **83** Type: **not specified**

The 154th HENPIC seminar by Dr. Yuxiang Zhao, IMP, CAS, Dec. 9th, 2021, Thursday, 10:30am (Beijing time)

talk title: Electron Ion Collider in China (EicC)
abstract:
Lepton scattering is an established ideal tool for studying inner structure of small particles such as nucleons as well as nuclei. As a future high energy nuclear physics project, an Electron-ion collider in China (EicC) has been proposed. It will be constructed based on an upgraded heavy-ion accelerator, High Intensity heavy-ion Accelerator Facility (HIAF) which is currently under construction, together with an additional electron ring. The proposed collider will provide highly polarized electrons (with the polarization ˜80%), protons and Helium-3 (both with the polarization ˜70%), as well as unpolarized ion beams from Carbon to Uranium with viable center of mass energy from 10 to 20 GeV and the luminosity of (2 ˜ 4) × 1033 cm−2·s−1.
The main foci of the EicC will be the precision measurements of the structure of proton in the sea quark region, including 3D tomography of nucleon which reveals the QCD dynamics; the partonic structure of nuclei and the parton interaction with the nuclear environment, in particular, the short range correlation of nucleons and the cold nuclear matter effects; the exotic states, especially those with heavy flavor quark contents. In addition, issues fundamental to understanding the origin of mass could be addressed by measurements of heavy quarkonia near-threshold production at the EicC. In order to achieve the above-mentioned physics goals, a hermetical detector system will be constructed with the cutting-edge technology. In this talk, the physics program, detector conceptual design and the project status will be reported.
In this talk, the physics program, detector conceptual design and the project status will be reported.
1 D. Anderle et al., Electron-ion collider in China, Front. Phys. 16 (2021) 64701

about the speaker: Yuxiang Zhao is now a staff scientist in the institute of modern physics. He received his B.S. and Ph.D. degree at University of Science and Technology of China. His Ph.D project is the transverse spin structure study of the nucleon at Thomas Jefferson Lab in the US. He has been awarded the “Outstanding Dissertation Award” by the International Organization of Chinese Physicists and Astronomers “for his significant contributions to a number of new analyses of the transversity data and to hardware and simulations for the SoLID project”. Then he joined Stony Brook University as a postdoctoral research associate to work on electro-weak physics in lepton-nucleon scatterings and continue his involvement in transverse spin structure study at JLab. Afterward, he joined INFN Trieste as INFN fellow to continue his expertise in Micro-Pattern-Gaseous-Detectors (MPGD) and the spin physics in the COMPASS experiment at CERN SPS. After joining IMP, he is mainly working on the Electron Ion Collider in China (EicC) and the Electron Ion Collider at Brookhaven National Laboratory in the US.

Contribution ID: **84** Type: **not specified**

The 155th HENPIC seminar by Dr. Song Zhang, Fudan Uni., Dec. 23rd, 2021, Thursday, 10:30am (Beijing time)

Title: α-cluster structure influence in relativistic heavy-ion collisions

Abstract:Relativistic heavy-ion collisions aim at searching for the quark-gluon plasma (QGP) and investigating its properties. Collective flow is one of the excellent probes of QGP and many observables in the collisions are constructed based on the collective flow itself or the flow analysis method. The influence from nuclear structure is important for understanding how the initial geometry asymmetry transfers to the final state momentum space. α-clustered nuclei with intrinsic geometry shape is one of the main sources of the initial geometry properties in the collisions. Recently we employed a multi-phase transport model to simulate the relativistic heavy-ion collisions involving the α-clustered 12”C” and 16”O” at RHIC and LHC energies. By analyzing the simulated events, collective flow, multiplicity correlation and distinguishing the structure by a classifier of machine learning model are investigated. Comparing results among different configurations of the nuclear structure, new observables are proposed as sensitive probes to distinguish the exotic nuclear structure in heavy-ion collisions.

About the speaker:Dr. Song Zhang received his B.S. degree at Hebei Uni. in 2001 and PhD degree at Shanghai Institute of Applied Physics in 2009 (Supervisor Prof. Yu-Gang Ma.) Dr. Zhang is a member of the RHIC-STAR and CERN-ALICE Col, with research interest in the particle correlation, collective flow, coalescence mechanism in relativistic heavy-ion collisions from large system to small system. Recently he also pays more attention to the initial state involving the influence from the α-clustered nuclei structure in relativistic heavy-ion collisions.

Contribution ID: **85** Type: **not specified**

The 156th HENPIC seminar by Dr. Yifeng Sun, Uni. of Catania, January 6th, 2022, Thursday, 10:30 am (Beijing time)

Title: Impact of the initial electromagnetic field on heavy quarks and leptons from Z0 decay and Z0 leptonic invariant mass

Speaker: Dr. Yifeng Sun, University of Catania

Abstract: Ultra-relativistic heavy ion collisions are expected to generate a huge electromagnetic (e.m.) field that is envisaged to induce several effects on hot QCD matter including the possibility of local parity and local parity and charge conjugation symmetry violations. A direct signature of such e.m. fields and a first quantitative measurement of its strength and lifetime are still missing. We will discuss why it is expected to generate a splitting of the directed flow of charged particles and anti-particles, which allow to constraint the e.m. field and can be considered also as a possible probe of the formation of the quark-gluon plasma phase. Moreover, we have found a general formula for all possible charge dependent flow observables that can be generated by the strong electromagnetic fields in non-central relativistic heavy ion collisions. The formula has a very simple form at pT larger than several GeV/c, which can be treated as the signature of charged dependent flow observables induced by e.m. fields. Furthermore, we found that the v1 splitting depends critically on the time evolution of the magnetic field. Based on this study, we finally discuss why the measurement of leptons from Z0 decay and its correlation to the charmed mesons are better in probing e.m. fields and thus opening a new way to constrain the EM field. The second topic we want to discuss is the modification of the Z0 leptonic invariant mass in the presence of EM fields. We found that EM fields will decrease the Z0 leptonic invariant mass and increase the width of it by few hundred MeV if the large Δ□_1 of D0 and anti-D0 measured by ALICE is all due to EM fields. Moreover, both the invariant mass and its width are found to approximately depend on the integral of magnetic field quadratically. This provides an independent way to constrain the EM field.

About the speaker: Yifeng Sun received his Ph.D. degree at Texas A&M Uni. in 2017 and has worked as a postdoc in Texas A&M Uni., INFN Southern National Lab. and Uni. of Catania. His research interests covered many areas of heavy ion physics mainly on the anomalous transport phenomena emergent in QGP induced by the strong magnetic and vorticity fields and finding ways to probe these strong fields.

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

The 157th HENPIC seminar by Dr. Chunjian Zhang, Stony Brook Uni. Jan. 20, 2022, Thursday, 10:30am (Beijing time)

Talk title: Imaging the shape of nuclei at high-energy colliders: towards a new type of nuclear phenomenology

Abstract:Nuclear deformation is a ubiquitous phenomenon for most atomic nuclei, reflecting collective motion induced by interaction between valance nucleons and shell structure. Recent progress in hydrodynamic modeling together with the wealth of precision collective flow data, however allow us to not only perform quantitative extractions of the transport properties of the QGP, but very importantly start to strongly constrain the initial state of the colliding nuclei. In this talk, I will show the precision measurements of bulk observables, such as flow coefficients, mean transverse momentum fluctuations, and their Pearson correlation coefficients. The use of which can be used to infer the
shape of the colliding nuclei, and thus obtain quantitative information about their
structure in the experiments. I will also discuss the comparison of such data with the state-of-the-art model calculations, and show that it permits us to clearly identify the nuclear deformations. These results demonstrate high-energy colliders as a new experimental test to image the structure of atomic nuclei.

About the speaker: Chunjian Zhang is a postdoctoral researcher at Stony Brook University. He received his Ph.D from Shanghai Institute of Applied Physics (SINAP) in 2019.12. Currently, his research works focus on the experimental and phenomenological study of correlations and fluctuations in relativistic heavy-ion collisions.

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

The 158th HENPIC seminar by Dr. Yi-Lun Du, University of Oslo, Feb. 10th, Thursday, 15:00 (Beijing time)

TITLE: Deep learning jet modifications in heavy-ion collisions

ABSTRACT: Jet interactions in a hot QCD medium created in heavy-ion collisions are conventionally assessed by measuring the modification of the distributions of jet observables with respect to the proton-proton baseline. However, the steeply falling production spectrum introduces a strong bias toward small energy losses that obfuscates a direct interpretation of the impact of medium effects in the measured jet ensemble. In this talk, we will discuss employing a convolutional neural network to extract the energy loss ratio from jet images on a jet-by-jet basis using the hybrid strong/weak coupling model. The angular distribution of soft particles in the jet cone is found to contain significant discriminating power. With a well-predicted energy loss ratio, we study a set of jet observables to estimate their sensitivity to bias effects and reveal their medium modifications. We show how this new technique provides unique access to the initial configuration of jets over the transverse plane of the nuclear collision, both with respect to their production points and initial orientations. As a relevant example, we demonstrate the capability of our method to locate with precision the production point of a dijet pair in the nuclear overlap region, in what constitutes an important step forward towards the long term quest of using jets as tomographic probes of the quark-gluon plasma. Finally, we also discuss the classification task of quark- versus gluon-initiated jets in heavy ion collisions with deep learning.

1 Yi-Lun Du, Daniel Pablos, Konrad Tywoniuk, Deep learning jet modifications in heavy-ion collisions, JHEP. 2021, 206 (2021)

[2] Yi-Lun Du, Daniel Pablos, Konrad Tywoniuk, Jet tomography in heavy ion collisions with deep learning, Phys. Rev. Lett. 128, 012301 (2022)

[3] Yi-Lun Du, Daniel Pablos, Konrad Tywoniuk, Classification of quark and gluon jets in hot QCD medium with deep learning, arXiv: 2112.00681 [hep-ph]

ABOUT THE SPEAKER: Dr. Yi-Lun Du is currently a postdoc at University of Oslo. After long-term visits to Central China Normal University and Frankfurt Institute of Advanced Studies, he obtained his PhD from Nanjing University in late 2018. Then he worked as a postdoc at FIAS and University of Bergen. His research focuses on understanding the QCD phase transition and studying jet-medium interactions to probe QCD medium properties. Theoretical tools and machine learning techniques are employed in his studies.

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

The 159th HENPIC seminar by Prof. Yi-Bo Yang, ITP/CAS (中科院理论物理研究所)，Feb. 24, 2022, Thursday, 10:30am (Beijing time)

Title: Hadron mass and its origin

Abstract:Quantum chromodynamics (QCD) claims that the major source of the nucleon invariant mass is not the Higgs mechanism but QCD energy momentum tensor trace anomaly, and further decomposition is favorable through different components of the QCD Hamiltonian. I will introduce the present lattice QCD progress on the hadron mass origin and discuss current challenges.

1 Yi-Bo Yang et al., Meson mass decomposition from Lattaice QCD, Phys. Rev. D 91 (2015) 074516
[2] Yi-Bo Yang et al., Proton mass decomposition from the QCD energy momentum tensor, Phys. Rev. Lett. 121 (2018) 21
[3] W. Sun, Y. Chen, P. Sun, Yi-Bo Yang, Gluons in charmoniumlike states, Phys. Rev. D 103 (2021) 9
[4] F. He, P. Sun, Yi-Bo Yang, Demonstration of the hadron mass origin from the QCD trace anomaly, Phys. Rev. D 104 (2021) 7

About the speaker:Yi-Bo Yang is currently an associate professor at ITP/CAS. He got his Ph.D from ITP/CAS in late 2010, and worked as a postdoc at IHEP/CAS, University of Kentucky, and Michigan state university. His research focuses on the strong-interaction origin of the hadron mass, spin and also their distributions inside the hadron. He also works on the lattice QCD software for the Domestic E-scale computers.

Contribution ID: **89** Type: **not specified**

The 160 HENPIC seminar by Dr. Xinye Peng (彭忻烨), China University of Geosciences (中国地质大学), March 10, 2022, Thursday 10:30 (Beijing time)

TITLE: Recent open heavy-flavour results with ALICE at the LHC

Dr. Xinye Peng, China University of Geosciences (Wuhan)

Abstract:
In the ultra-relativistic heavy-ion collisions at the Large Hadron Collider (LHC), a state of color-deconfined matter, called quark-gluon plasma (QGP), is created. Heavy quarks are produced in the early stage of the collisions, they suffered the entire evolution of the medium, hence they are the effective probes of the medium properties. Models describing the heavy-flavour transport in an hydrodynamically expanding medium require also a precise modelling of the heavy-quark hadronisation mechanisms in the QGP medium. Experimentally, this information is provided via measuring ratios between different hadron species. Besides, the charmed baryon-to-meson ratios are sensitive tools to investigate charm hadronisation mechanisms in small systems, exploring if charmed hadron formation in hadronic collisions differs from the element (e.g., ee and ep) collisions.

In this talk, systematic measurements of charm meson and baryon production with ALICE will be presented, focusing on understanding the charmed baryon-to-meson enhancement in small systems. Measurements on the production and elliptic flow of charm and beauty hadrons in heavy-ion collisions will be discussed as well. Such studies will help to reveal heavy quark energy loss and diffusion properties in the QGP medium.

Refs: JHEP05 (2021) 220; PRL 127 (2021) 20, 202301; arXiv: 2111.11948; JHEP10 (2021) 159; PRD 105, L011103; arXiv: 2110.09420; arXiv: 2110.10006; arXiv:2112.08156; arXiv:2202.00815; PRL 126 (2021) 162001

About the speaker: Xinye Peng received his joint Ph.D. degree at Central China Normal University (CCNU) and Padova University in 2019, and worked as a postdoc at CCNU, he is currently an associate professor at China University of Geosciences (Wuhan). His research focuses on charm and beauty production and collective flow in the ALICE experiment, he serves as ALICE fully reconstructed charm hadron decays (D2H) analysis group coordinator now.

Contribution ID: **90** Type: **not specified**

The 161th HENPIC seminar by Dr. Wenbin Zhao, from Wayne State University, on Thursday 10:30 am, March 24 (https://lbnl.zoom.com.cn/j/421173735)

Title: Coupled approach to solving the ⊗ puzzle and the collectivity in ultra-peripheral Pb+Pb collisions

Abstract: In the first part of the talk, we combine hydrodynamics, quark coalescence and jet quenching as well as the hadron cascade, and study their effects on hadron spectra and flow. Our new theoretical framework combines 1) the Coupled Linearized Boltzmann Transport and Hydrodynamic (CoLBT-Hydro) model, 2) a hadronization model including Cooper-Frye sampling, quark coalescence and string fragmentation, and 3) a hadron cascade model. For the first time, we can consistently describe and understand the experimental data on RAA and v2 along with their flavor dependence and hadron chemistry (proton-to-pion and kaon-to-pion ratios) from low to intermediate pT and high pT in heavy-ion collisions at both RHIC and LHC energies.

On the other hand, intriguing collectivity features in ultra-peripheral Pb+Pb collisions (UPCs) also have been measured at the LHC. I will also present the first full (3+1)D dynamical simulations of UPCs at the LHC. Extrapolating from p+Pb collisions, we provide hydrodynamic calculations for charged hadron multiplicity, identified particle mean transverse momenta, and anisotropic flow coefficients in gamma*+Pb collisions. The elliptic flow hierarchy between p+Pb and gamma*+Pb collisions is dominated by the difference in longitudinal flow de-correlations and reproduces the experimental data well. Our theoretical framework provides a quantitative tool to study collective behaviors for all system sizes, ranging from central heavy-ion collisions to small asymmetric systems and those at the future Electron-Ion Collider.

1 Wenbin Zhao, Weiyao Ke, Wei Chen, Tan Luo and Xin-Nian Wang, Phys. Rev. Lett. 128 (2022) no.2, 022302.

[2] Wenbin Zhao, Che-Ming Ko, YuXin Liu, Guangyou Qin and Huichao Song, Phys. Rev. Lett. 125, 072301 (2020).

[3] Wenbin Zhao, Chun Shen and Björn Schenke, [arXiv: 2203.06094].

About the speaker: Wenbin Zhao is currently a postdoc at Wayne State University. He received his Ph.D degree at Peking University in 2020 and worked as a Research Assistant at CCNU during 2020 - 2021. His research covered many areas of heavy-ion collisions and mainly on the collectivity, hadronization process and light nuclei production in large and small systems.

Contribution ID: **91** Type: **not specified**

The 162th HENPIC seminar by Dr. Qipeng Hu, from Lawrence Livermore National Laboratory, on Thursday 10:30 am, April 14 (https://lbnl.zoom.com.cn/j/421173735)

Title: Recent heavy-flavor and jet substructure results from ATLAS

Abstract: Latest measurements of heavy-flavor and jet substructure in Pb+Pb collisions from ATLAS are presented in this seminar. Heavy-flavor (charm and bottom) quarks and energetic jets in A+A collisions serve as powerful tools to study quark-gluon plasma (QGP) properties and QGP-induced energy loss.

Nuclear modification factor (RAA) and azimuthal anisotropy of the muons from charm and bottom hadron decays are used to probe the average and differential modifications of heavy-flavor quark production in QGP. The simultaneous measurement of multiple observables for both charm and bottom with the same detector and technique is crucial in providing constraints to state-of-the-art theoretical predictions.

The angular scale of the first hard splitting, rg, inside R=0.4 jet is extracted by employing the soft drop grooming technique. Jet RAA is measured differentially in jet transverse momentum, rg and centrality. The resulting jet RAA strongly depends on rg and centrality but only weakly depends on jet transverse momentum. The strong rg dependence provides direct evidence in support of the picture of jet quenching arising from coherence.

About the speaker: Qipeng Hu joined Lawrence Livermore National Laboratory as postdoc in June 2020. Based on data collected by the ATLAS experiment at the LHC, his primary research focuses on heavy-flavor / jet production in heavy-ion collisions, and collectivity in small systems. Qipeng received his PhD in particle physics from the University of Science and Technology of China in 2017. He was a postdoc at University of Colorado Boulder from 2017 to 2020.

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

The 163th HENPIC seminar by Yayun He (贺亚运), South China Normal Uni., April 28, 2022, Thursday, 10:30am (Beijing)

Title: Jet energy loss distributions, anisotropy flow, and transverse gradient tomography of jet quenching in heavy-ion collisions.

Abstract: Energy loss and transverse momentum broadening of a propagating parton are twin consequences of jet quenching due to the interaction with the QGP produced in heavy-ion collisions. On one hand, based on the factorization in perturbative QCD, we firstly employ state-of-the-art Bayesian analysis to extract jet energy loss distributions for single inclusive and $\gamma-$triggered jets in Pb+Pb collisions with different centrality bins at $\sqrt{s} = 2.76$ and 5.02 TeV at the LHC. The extracted jet energy loss distributions have a large width with a scaling behavior in $x = \Delta p_T/\langle\Delta p_T\rangle$. The averaged jet energy loss extracted increases with the initial jet p_T that is slightly stronger than a logarithmic form. These results indicate there are a few out-of-cone jet-medium scatterings that are consistent with the LBT simulations and can help constrain uncertainties of jet transport models.

In addition to studying averaged jet energy loss leading to jet suppression, we also investigate the azimuthal anisotropy of jet energy loss which gives rise to jet anisotropy flow. We investigate the colliding energy, centrality, jet transverse momentum dependence of the jet anisotropy, as well as their event-by-event correlation with the flow coefficients of the soft bulk hadrons. An approximate linear correlation between jet and bulk v_2 is found. The jet-induced medium excitation, which is influenced by radial flow, is shown to enhance $v_2^{\rm jet}$ and the enhancement increases with the jet cone size.

On the other hand, the spatial gradient of jet transport coefficient $\hat{q}$ perpendicular to the propagation direction can lead to a drift and asymmetry in parton transverse momentum distribution. Such an asymmetry depends on both the spatial position along the transverse gradient and path length of a propagating parton as shown by numerical solutions of the Boltzmann transport in the simplified form of a drift-diffusion equation. In high-energy heavy-ion collisions, this asymmetry with respect to a plane defined by the beam and trigger particle (photon, hadron, or jet) with a given orientation relative to the event plane is shown to be closely related to the transverse position of the initial jet production in full event-by-event simulations within the LBT model. Such a gradient tomography can be used to localize the initial jet production position for a more detailed study of jet quenching.

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

The 164th HENPIC seminar by Dr. Jianhui Zhu, INFN-Padova (IT), May 12th, 2022, Thursday, 10:30am (Beijing time)

Title of the talk: Heavy-flavor production and hadronisation with ALICE at the LHC

Abstract:
The transition from quarks to hadrons is a fundamental process in nature that can be studied at colliders. Given their mass on the GeV scale, charm and beauty quarks are mainly produced in the hard scattering processes occurring in the early stages of the hadronic collisions. Compared to the hadronization, their production time is negligible, differently from light quarks. Thus, heavy quarks are used as markers to study the hadronization processes.

Recent results at the LHC show a significant enhancement of charmed baryon-to-meson ratios in pp collisions with respect to eˆ+ eˆ- and eˆ-p collisions, assessing a possible non-universality of fragmentation functions among collision systems. These results suggest that the presence of surrounding colour charges may significantly influence the charm quark hadronization. Similar to what is expected in the quark-gluon plasma produced in ultra-relativistic heavy-ion collisions, heavy quarks can hadronize by combining with nearby lighter quarks in a process commonly called "coalescence" that modifies the hadro-chemistry expected in a pure fragmentation scenario.

In this seminar, the most recent measurements with the ALICE experiment of charm baryon production (Λ_cˆ+, Σ_cˆ(0,+,++), Ξ_cˆ(0,+), Ω_cˆ0 in pp collisions, and Λ_cˆ+ in p-Pb and Pb-Pb collisions) and an extension to the beauty sector via the measurement of Λ_cˆ+ originating from beauty hadron decays will be presented. The comparison with theoretical model calculations will be discussed as well.

A brief introduction of the speaker:
Jianhui Zhu received his joint Ph.D. degree at IMT Atlantique (FR) and Central China Normal University (CN) in 2017, and worked as a postdoc at GSI (DE) for three years. He is currently a postdoc at INFN-Padova (IT). His research focuses on heavy-flavor production and hadronisation, vertex reconstruction with Kalman Filter, development of the online and offline (O2) analysis software framework for upgrade in the ALICE experiment.

Contribution ID: **94** Type: **not specified**

The 165th HENPIC seminar by Prof. Jiangming Yao, Sun Yet-sen University, May 26, 2022, Thursday 10:30am (Beijing time)

Title: Advances in modeling nuclear matrix elements of neutrinoless double beta decay

Abstract: Nuclear weak decays provide important probes to fundamental symmetries in nature. In particular, an observation of the hypothetical neutrinoless double-beta ($0\nu\beta\beta$) decay would unambiguously demonstrate the Majorana nature of neutrinos and the existence of the lepton-number-violation process. It would also provide unique information on the ordering and absolute scale of neutrino masses. The next-generation tonne-scale experiments will probably provide a definite answer to these fundamental questions based on our current knowledge of the nuclear matrix element (NME), the precise determination of which is a challenge to nuclear theory and requires comprehensive knowledge of both the strong and weak interactions in the nuclear medium and of the dynamics of quantum many-body systems. In this seminar, the advances in the studies of the NME assuming the standard mechanism of an exchange of light Majorana neutrinos will be highlighted. The challenges and prospects will be discussed.

About the speaker: Jiangming Yao received his doctorate degree from Peking University in 2009. After holding research positions at Southwest University, Université libre de Bruxelles, Tohoku University, the University of North Carolina at Chapel Hill, and Michigan State University, he joined Sun Yat-sen University in 2021 as a full professor. His research interest is nuclear theory and its application to interdisciplinary fundamental problems in nuclear physics, particle physics, and astrophysics.

Contribution ID: **95** Type: **not specified**

The 166th HENPIC seminar by Dr. Kaijia Sun, Texas A&M University, June 9th, 2022, Thursday, 10:30 am (Beijing time)

Title: Spinodal Enhancement on Light Nuclei Yield Ratio in Relativistic Heavy Ion Collisions

Abstract: The search for a first-order phase transition and the critical point (CP) in the phase diagram of Quantum Chromodynamics (QCD) is the central goal of the beam energy scan (BES) program in relativistic heavy ion collisions. Due to the composite structures of loosely bound nuclei, their yields are expected to carry important information on the baryon density fluctuation and correlation developed during the possible non-smooth QCD phase transitions in relativistic heavy ion collisions. In this talk, I will report our recent progress and findings in this direction.

Specifically, we develop a novel relativistic transport model with a first-order phase transition incorporated into the partonic dynamics, which enables us to study the effect of a first-order phase transition in the equation of state of this matter on the yield ratio $N_t N_p/N_d^2$ (tp/d^2) of produced proton (p), deuteron (d), and triton (t). With this approach, we demonstrate for the first time that the large density inhomogeneities generated by the spinodal instability during the first-order phase transition can survive the fast expansion of the subsequent hadronic matter and lead to an enhanced tp/d^2 in central collisions at $\sqrt{s_{NN}} = 3-5$ GeV as seen in the experiments by the STAR Collaboration and the E864 Collaboration. Moreover, this enhancement subsides with increasing collision centrality, and the resulting almost flat centrality dependence of tp/d^2 at $\sqrt{s_{NN}} = 3$ GeV can also be used as a signal for the first-order phase transition.

Contribution ID: **96** Type: **not specified**

The 167th HENPIC seminar by Prof. Min He, Nanjing University of Sci. & Tech., June 23th, Thursday, 10:30 am (Beijing time)

Title: Collectivity of J/ψ Mesons in Heavy-Ion Collisions

The production of J/ψ mesons in heavy-ion collisions at the Large Hadron Collider is believed to be dominated by the recombination of charm and anticharm quarks in a hot QCD medium. However, measurements of the elliptic flow (v2) of J/ψ mesons in these reactions are not well described by existing calculations of J/ψ recombination for transverse momenta pT ⊠ 4 GeV. We revisit these calculations in two main aspects. Employing the resonance recombination model, we implement distribution functions of charm quarks transported through the quark-gluon plasma using state-of-the-art Langevin simulations and account for the space-momentum correlations of the diffusing charm and anticharm quarks in a hydrodynamically expanding fireball. This extends the relevance of the recombination processes to substantially larger momenta than before. We also revisit the suppression of primordially produced J/ψ’s
by propagating them through the same hydrodynamic medium, leading to a marked increase of their v2 over previous estimates. Combining these developments into a calculation of the pT-dependent nuclear modification factor and v2 of inclusive J/ψ production in semicentral Pb-Pb collisions at the LHC, we find a good description of the experimental results by the ALICE Collaboration. Our results thus resolve the abovementioned v2 puzzle and imply the relevance of recombination processes for pT’s of up to ~8 GeV.

About the speaker: Min He earned his PhD from Nanjing University and then moved to Texas A&M University as a postdoc. Now he is a faculty member at Nanjing University of Science & Technology. His research interest lies in the field of heavy quark and quarkonium physics in the quark-gluon plasma.

Contribution ID: **97** Type: **not specified**

The 168th HENPIC seminar by Prof. Xiaozhi Bai, USTC, July 7th, Thursday, 10:30am (Beijing time)

Talk title: Recent quarkonium measurements with ALICE

Abstract:
Quarkonium production is one of the essential probes to the properties of the quark-gluon plasma (QGP) formed in relativistic heavy-ion collisions. The suppression of J/ψ due to color screening in the medium was initially proposed as a direct evidence of QGP formation. The final observed J/ψ are influenced by the (re-)generation of uncorrelated charm-anticharm pairs in the medium and the underlying cold nuclear matter effects. Measurement of J/ψ production in pp collisions can be used to test the J/ψ production in vacuum. Particularly, it can be used as a reference to study the nuclear modification factor RpA in p-Pb and RAA in Pb-Pb collisions. The production in p-Pb collisions would help quantify the cold nuclear matter (CNM) effects. In the case of the heavier quarkonium state, the (re-)generation effect is expected to be significantly smaller since the density of uncorrelated beauty-antibeauty pairs in the medium is much smaller than the charm pairs.

In this talk, I will review the recent measurements of both J/ψ and Y production in 5.02 TeV, 8.16 TeV and 13 TeV with ALICE. The measured inclusive, non-prompt J/ψ production cross section, the nuclear modification factor RpA, RAA, and the flow coefficient v2 will be shown. In addition, both J/ψ and Y polarization measurements will be discussed in different collision systems. All the measured results will be compared with the model calculations.

About the speaker:
Xiaozhi Bai obtained his PhD from Central China Normal University in 2017, he worked as a visiting student from 2013 to 2017 at the University of Illinois at Chicago for STAR experiment, and then he moved to GSI Helmholtz Centre for Heavy Ion Research and worked as a postdoc from 2018 to 2021 for ALICE collaboration. He is an associate professor at the University of Science and Technology of China since the earlier of 2021. His research focuses on the open heavy flavor and quarkonium measurements in high-energy collisions.

Contribution ID: **98** Type: **not specified**

The 169th HENPIC seminar by Prof. Feng Li, Lanzhou Univ., July 21, 2022, Thursday, 10:30 am (Beijing time)

Title: Jet Quenching at Finite Chemical Potentials and Near the Critical End Point

(https://lbnl.zoom.us/j/421173735?pwd=Z0IwTlM3eDB6UUo1L0VjaXdTQ2hBQT09)

Abstract: Jet quenching parameter $\hat{q}$ is an essential parameter that characterizes the interaction strength between jet partons and the QGP. Based on the quark-meson model, we conduct a first calculation on $\hat{q}$ at finite chemical potential up to the one-loop order, and find that the momentum broadening of jets is enhanced not only at high temperature, but also at high chemical potential. More precisely, the value of $\hat{q}$ in the chiral symmetry restored phase is found proportional to the parton number density. We further investigate the behavior of $\hat{q}$ near the critical end point (CEP) of the QCD phase diagram by coupling our calculation with a recently developed equation of state that includes a CEP in the
universality class of the Ising model.

About the speaker:
李峰，兰州大学青年研究员。2008 年于上海交通大学获得物理学学士学位，2016 年于 Texas A&M Univ. 获得理论核物理方向博士学位。2016-2018 年赴 Frankfurt Institute for Advanced Studies(FIAS) 从事博士后研究工作。2019 年 6 月以青年研究员身份加入兰州大学。目前的研究兴趣主要集中在大重子数夸克物质转向强子物质的相变、亚阈值重离子碰撞中奇异粒子的产额以及带自旋夸克的反常运动。

Contribution ID: **99** Type: **not specified**

The 170th HENPIC seminar by Prof. Qun Wang, and Dr. Xu Sun, a topical discussion on vector meson global spin alignment, August 4, 2022, Thursday, 10:30am (Beijing time)

Title: Spin alignments of vector mesons - new frontier of spin dynamics

Speaker: Prof. Qun Wang, USTC

Abstract:We present a relativistic spin Boltzmann equation (SBE) for spin dynamics of vector mesons based on Kadanoff-Baym equations. Using SBE and an effective quark-meson model, we calculate ρ_{00} (the 00-element of the spin density matrix) for ϕ mesons in heavy-ion collisions formed by the coalescence of s and $\overline{s}$ quarks which are assumed to be polarized by the vorticity and ϕ fields. We show that the contributions to ρ_{00} from the vorticity and ϕ fields all appear as local correlation between strong force fields of the same kinds and same components. This indicates that fluctuations of strong force fields play an important role in ρ_{00}, which can be formulated and extracted in relativistic quantum transport theory. Our results on the colliding energy, transverse momentum and centrality dependence of ρ_{00} are in good agreement with recent STAR data for ϕ mesons.

Talk2:

Title: Observation of Global Spin Alignment at RHIC-STAR

Speaker: Xu Sun, UIC

Abstract: In non-central heavy-ion collisions (HIC), the large initial angular momentum can induce a non-vanishing polarization for hadrons with non-zero spin. The global spin alignment of vector mesons, quantified by the 00th element of spin density matrix element ($_{00}$), can offer information on the spin-orbital interactions of the QCD medium. Surprisingly large signal of vector meson $_{00}$ compared to hyperon spin polarization poses challenges to the conventional theoretical understanding of polarization in HIC.

In this talk, we will present the first observation of vector meson spin alignment signal from RHIC-STAR experiment. This observation from Beam Energy Scan (BES-I) include large deviations of $_{00}$ from 1/3 for ϕ mesons, which can only be explained by introducing the vector meson strong force fields. We will also discuss the transverse momentum and collision centrality dependence of the global spin alignment signal at BES-I. In addition, we will briefly discuss the new measurement using recent high statistics Beam Energy Scan (BES-II) Au + Au collisions at 19,6 GeV, and isobar collisions (Zr+Zr and Ru+Ru) at 200 GeV. The BES-II data will provide unprecedented precision in $_{00}$ at these energies. Comparison of $_{00}$ in Au+Au and isobar species can provide information on the system size dependence of $_{00}$. Moreover, since the magnetic moment of charged and neutral K^* differ by a factor of seven, the comparison of their $_{00}$ may serve as a new probe for the initial strong magnetic field in HIC.

Contribution ID: **100** Type: **not specified**

The 171th HENPIC seminar by Prof. Jian-ping Chen (JLab), Aug. 18th, Thursday, 10:30 am (UTC+8)

Talk Title: Overview of the JLab SoLID Program: Intensity Frontier for High Energy Nuclear Physics

Abstract: The SoLID device at Jefferson Lab pushes the limit of the intensity frontier to a new level. The advancements in detector, data acquisition and data processing technologies enables SoLID to have orders-of-magnitude improvement in figure-of-merit (luminosity and acceptance) over the existing devices. A rich vibrant physics program is planned in precision imaging of the 3-d structure of the nucleon, a precision test of physics beyond the Standard Model and an exploration of the gluonic field effects in proton properties. An overview of the SoLID physics program will be presented along with the current status of SoLID.

About the speaker: Chen, Jian-ping (陈剑平) is a Senior Staff Physicist at Jefferson Lab. He is a spokesperson for over a dozen JLab experiments. He is a project manager and member of the executive committee for SoLID. His research interests are on spin and 3-d structure of the nucleon, few-body physics and low energy test of Standard Model. He also leads efforts in advancement of polarized 3He target. He received his B.S. from USTC in 1982; came to US for graduate study through CUSPEA program; received PhD from U. of Virginia in 1990; did postdoc at U. Virginia and MIT before joining Jefferson Lab as a Staff Physicist in 1994.

Summary

Contribution ID: **101** Type: **not specified**

The 172nd HENPIC seminar by Dr. Jianwei Qiu (邱建伟)

Title: Nuclear Femtography - QCD and hadron physics at a Fermi scale

Abstract: The proton and neutron, collectively called nucleons, are the fundamental building blocks of all atomic nuclei that make up essentially all the visible matter in the universe. More than 50 years of study has revealed that nucleons are composed of elementary particles called quarks and gluons, whose interactions and dynamics are governed by Quantum Chromodynamics (QCD). However, many profound questions remain, such as how did nucleons and their properties be emerged from quarks and gluons? what is the internal structure of nucleons? how does the glue bind us all? Developing a deeper understanding of these building blocks of the visible matter is one of the grand challenges of modern science. In this talk, I will introduce the Nuclear Femtography, as a new frontier of Science and Technology, and explain how it will help us to search for answers to the most compelling unanswered questions about the elementary building blocks of our visible world. I will also demonstrate how a high energy and high luminosity lepton-hadron facility could be capable of exploring the inner structure of nucleons and nuclei with sub-femtometer resolution, and could be the best facility for studying Nuclear Femtography, dealing with emerging phenomena of QCD at a Fermi scale, which is the most interesting, rich, and complex regime of the strong interacting theory!

About the speaker: Jianwei Qiu is currently the Associate Director for Theoretical & Computational Physics and the director for Theory Center at Jefferson Lab. He received his Ph.D. in theoretical physics in 1987 from Columbia Univ., and was a postdoc at ANL and at Stony Brook Univ.. In 1991, Qiu joined Iowa State University. He moved to BNL/Stony Brook Univ. in 2010. His research focus is in QCD and its applications in high-energy particle and nuclear physics.

Summary

Contribution ID: **102** Type: **not specified**

The 173rd HENPIC seminar by Prof. Xiaojun Yao (姚晓骏)

Title: Quantum Simulation for Heavy Ion Collisions

Abstract: The scientific objective of heavy ion collision experiments is to study the properties of the quark-gluon plasma (QGP), a hot and dense phase of nuclear matter. Perturbative calculations and nonperturbative methods such as the lattice method and the holography at finite temperature have led to many interesting results regarding the QGP properties. However, there are still many open questions that cannot be fully addressed by traditional methods, especially those related to finite baryon chemical potentials and the real-time dynamics.
With the rapid development of quantum technology recently, it may be possible that we can use quantum computing to solve some difficult problems in our understanding of QCD at finite temperature and density in the near future. In this talk, I will discuss two examples in which quantum computing may help to deepen our understanding. The first example is the non-unitary and non-equilibrium dynamics of open quantum systems. The open quantum system framework has been used to describe the transport of heavy quarks and quarkonia in the QGP, but current studies are limited to a small number of degrees of freedom. Quantum computers may help to overcome this problem. I will explain the quantum simulation of the non-unitary dynamics of a two-level system and the U(1) gauge theory in 1+1-dimension, also known as the Schwinger model, embedded in a thermal environment. The second example is jet quenching. I will show a framework for the quantum simulation of the light-front Hamiltonian dynamics of QCD, which can be used to study the Landau-Pomeranchuk-Migdal effect in jet quenching beyond the current methods' scope.

Summary

Contribution ID: **103** Type: **not specified**

The 174th HENPIC seminar by Prof. Guang-You Qin (秦广友)

Title: Jets and heavy flavors in heavy-ion collisions

Abstract: When the matter is heated up to 2 trillion degrees Kelvin, the quark-gluon plasma (QGP) can be formed. Such new state of matter consist of deconfined quarks and gluons, which are ordinarily confined inside nucleons or other hadrons. It is believed that shortly after the Big Bang, the early universe was filled with hot and dense QGP. The primary goal of relativistic heavy-ion collisions is to create QGP in the laboratories, to study its novel properties and to explore the phase structure of strong-interaction matter under extreme conditions. Jets and heavy flavors provide very important tools to probe the macroscopic properties and microscopic structures of quark-gluon plasma created in high-energy nuclear collisions. In this talk, I will present some recent theoretical and phenomenological studies on jet quenching, medium response and heavy flavor dynamics related to the Relativistic Heavy-Ion Collider and the Large Hadron Collider.

Summary

Contribution ID: **104** Type: **not specified**

The 175th HENPIC seminar by Dr. Xiaoxuan Chu (褚晓璇)

Title: Di-hadron correlations and implication of gluon saturation

Abstract: The gluon distribution function grows with lower and lower momentum fraction very fast. As the total scattering cross section is bound by quantum mechanics, the raise of the gluon density has to be tamed, which is explained by gluon recombination under the color glass condensate (CGC) framework. A definitive discovery of nonlinear effects in QCD and as such the saturation regime would significantly improve our understanding of the nucleon structure and of nuclear interactions at high energy. Two particle azimuthal correlation is one of the most direct and sensitive channels to access the underlying nonlinear gluon dynamics. In this talk, we will present the recent results of forward di-hadron correlations measured at RHIC, together with the signatures of gluon saturation predicted by CGC. New opportunities for measurements with the STAR forward upgrade and future EIC to study the nonlinear effects in QCD will also be discussed.

Summary

Contribution ID: **105** Type: **not specified**

The 176th HENPIC topic discussion on UPC by Profs. Shi Pu (浦实) and Wangmei Zha (查王妹)

Title: Lepton pair photoproduction in peripheral, ultra-peripheral and isobar heavy-ion collisions

Abstract: We have studied the lepton pair photoproduction in ultra-peripheral, peripheral and isobar collisions in the classical field approximation with the wave packet description of nuclei. We derive a general form of the cross section in terms of photon distributions which depend on the transverse momentum and coordinate based on the wave packet form of nuclear wave functions. Such a general form of the cross section in the classical field approximation contains the results of the generalized equivalent photon approximation (EPA) as well as the corrections beyond EPA in the Born approximation. By rewriting the general form of the cross section in light-cone coordinates, we find a good connection with the transverse momentum dependent distribution (TMD) factorization formalism in the Born approximation. We present the numerical results for the distributions of the transverse momentum, azimuthal angle and invariant mass for e+e− and μ+μ− pairs as functions of the impact parameter and other kinematic variables in Au+Au collisions. With the charge and mass density distributions given by the calculation of the density functional theory, we calculate the spectra of transverse momentum, invariant mass and azimuthal angle for di-electrons in peripheral collisions of Ru+Ru and Zr+Zr at 200GeV.

Title: Experimental measurements of photon induced reactions from ultra-peripheral to hadronic heavy-ion collisions

Abstract: The coherent photon-nucleus and photon-photon interactions has been studied in detail to probe the gluon distribution in nucleus and to test QED via relativistic heavy-ion collisions. These kinds of interactions are traditionally thought to be only exist in ultra-peripheral collisions (UPC), where there is no hadronic interactions. However, recent experimental and theoretical progresses clearly demonstrate existence of coherent photoproduction mechanisms in hadronic heavy-ion collisions. The survival of photon induced products merits further experimental and theoretical investigations to study their properties and the link to the novel probe of QGP. In this talk, we report on the recent experimental measurements of the photon induced reactions from STAR. In corporation with the theoretical models, the physical implications of these measurements are discussed, which can shed new light on the future efforts in this field.

Summary

Contribution ID: **106** Type: **not specified**

The 177th HENPIC seminar by Ms. Fanyi Zhao

Title: Quantum Simulation for Phase Transitions

Abstract: The Nambu-Jona-Lasinio (NJL) model has been widely studied for investigating the chiral phase structure and chirality charge of strongly interacting matter. The study of the thermodynamics of field theories within the framework of Lattice Field Theory is limited by the sign problem, which prevents Monte Carlo evaluation of the functional integral at a finite chemical potential. Using the quantum imaginary time evolution (QITE) algorithm, we construct a quantum simulation for the (1+1) dimensional NJL model at finite temperatures, chemical potentials and chiral chemical potentials. We observe consistency among digital quantum simulation, exact diagonalization and analytical solution, indicating further applications of quantum computing in simulating QCD thermodynamics.

Summary

Contribution ID: **107** Type: **not specified**

The 178th HENPIC seminar by Prof. Jinfeng Liao

Title: Anomalous Transport in Chiral Matter

Abstract: Gauge fields provide the fundamental interactions in the Standard Model of particle physics. Gauge field configurations with nontrivial topological windings are known to play crucial roles in many important phenomena, from matter-anti-matter asymmetry of today's universe to topological phases in condensed matter. Their presence is however elusive for direct detection in experiments. It turns out that measurements of the so-called chiral magnetic effect (CME) in heavy ion collisions can be used to access and manifest gauge field topology. The CME is a nontrivial macroscopic transport process arising from microscopic quantum anomaly of underlying chiral fermions in chiral matter (e.g. a Dirac/Weyl semimetal or a quark-gluon plasma), which has been in the spotlight lately across disciplines of physics. Potential discovery of CME in heavy ion collisions is of utmost significance, with extensive experimental searches carried out over the past decade. Some twelve years after the first hint of a possible CME signal at the Relativistic Heavy Ion Collider (RHIC), important new measurements from a dedicated search via isobar collisions were released in 2021. After discussing the exciting physics of anomalous transport in chiral matter, this talk will focus on what we know (and don't know) about the CME search, with an emphasis on the key implications of the latest isobar dataset.

Summary

Contribution ID: **108** Type: **not specified**

The 179th HENPIC seminar by Dr. Zaochen Ye

Title: Probing a new regime of ultra-dense gluonic matter using high-energy photons with the CMS Experiment

Abstract: Gluons are found to become increasingly dominant constituents of nuclear matter when being probed at higher energies or smaller Bjorken-x values. This has led to the question of the ultimate fate of nuclear gluonic structure and its interaction with external probes at extreme density regimes when approaching the limit allowed by unitarity. In ultraperipheral collisions (UPCs) of relativistic heavy ions, the coherent heavy-flavor vector meson production via photon-nuclear interactions is of particular interest, since its cross section is directly sensitive to the nuclear gluon density. However, in experimental measurements, because each of the two nuclei in symmetric UPCs can serve both as a photon-emitter projectile and a target, this two-way ambiguity has prevented us from disentangling contributions involving high- and low- energy photon-nucleus interactions, thus limiting our capability of probing the extremely small-x regime, where nonlinear QCD effects are expected to emerge.
In this talk, we will present a new measurement of coherent J/Psi photoproduction, where the two-way ambiguity is solved by implementing for the first time a forward neutron tagging technique in UPC PbPb collisions at 5.02 TeV. The coherent J/psi photoproduction cross section will be presented, for the first time, as a function of the photon-Pb center-of-mass energy in UPCs up to about 400 GeV, corresponding to an extremely low x of ˜ 5x10-5. We will discuss the physics implications of this new result, as well as exciting opportunities in future LHC heavy ion runs.

Summary

Contribution ID: **109** Type: **not specified**

The 180th HENPIC seminar by Prof. Chun Shen

Title: 3D modeling of the collective behaviors in relativistic heavy-ion collisions

Abstract: Three-dimensional modeling of relativistic heavy-ion collisions has become an essential phenomenological tool for quantitatively studying Quark-Gluon Plasma's properties. In this seminar, I will discuss building a comprehensive 3D framework to study the collective bulk dynamics in heavy-ion collisions. This framework plays a central role in understanding the stopping dynamics in heavy-ion collisions at O(10) GeV and probes the phase structure of quantum chromodynamics at finite baryon density. It also helps us to explore non-trivial longitudinal dynamics in asymmetric small collision systems at high energies.

Summary

Contribution ID: **110** Type: **not specified**

The 181st HENPIC seminar by Prof. Craig D. Roberts

Title: Perspective on the Emergence of Nature’ s Principal Mass Scale

Abstract: Visible matter is characterised by a single mass scale; namely, the proton mass. The proton’s existence and structure are supposed to be described by quantum chromodynamics (QCD); yet, absent Higgs boson couplings, chromodynamics is scale invariant. Thus, if the Standard Model is truly a part of the theory of Nature, then the proton mass is an emergent feature of QCD; and emergent hadron mass (EHM) must provide the basic link between theory and observation. Nonperturbative, symmetry-preserving tools are necessary if such connections are to be made. In this context, I willl sketch recent progress in the application of continuum Schwinger function methods to an array of related problems in hadron and particle physics. Special emphasis will be given to the three pillars of EHM – namely, the running gluon mass, process-independent effective charge, and running quark mass; their role in stabilising QCD; their measurable expressions in a diverse array of observables; and the critical part played by Poincaré invariance in eliminating artificial dynamical effects, in particular, ensuring the invisibility of Lorentz Contraction.

Summary

Contribution ID: **111** Type: **not specified**

The 182nd HENPIC seminar by Dr. Wenbin Zhao

Title: Accessing structure of protons and nuclei at small x at the Electron-Ion Collider

Abstract:Determining the structure of protons and nuclei at high energy is one of central goals of the heavy-ion collisions and the future Electron-Ion Collider (EIC). To extract the proton shape fluctuations from HERA exclusive vector meson production data, we apply Bayesian inference and determine probabilistic constraints on the parameters describing the fluctuating structure of protons at high energy. We employ the color glass condensate framework, supplemented with a model for the spatial structure of the proton, along with experimental data from the ZEUS and H1 Collaborations on coherent and incoherent diffractive vector meson production in e+p collisions at HERA. We find out that this experimental data constrains most model parameters well. We also demonstrate that the complementary constraints can be obtained from hydrodynamic simulations of Pb+Pb collisions at the LHC.
For electron+nucleus collisions, we find out that the average nuclear geometric deformations and fluctuations affect diffractive vector meson productions, especially for the incoherent cross sections at small |t|. Also, the JIMWLK evolution doesn’ t wash out this effects. We systematically study the deformations effects of Uranium (U), Oxygen-16 (^{16}O), and Neon (^{20}Ne) on the diffractive J/Ψ productions. Our work demonstrate that the future EIC diffractive data can provide direct information on the nuclear structure at small x and the complementary constraints for the nuclear geometric shape for the traditional hydrodynamic models.

Summary

Contribution ID: **112** Type: **not specified**

The 183rd HENPIC seminar by Prof. Jun Xu

title: Probing neutron skin with free spectator nucleons in ultracentral relativistic heavy-ion collisions

abstract:
The neutron-skin thickness is one of the most robust probes of the slope parameter of the nuclear symmetry energy, which is responsible for the main uncertainty of the nuclear matter equation of state. Relativistic heavy-ion collisions may serve as a complementary measurement of the neutron-skin thickness, in addition to various methods in nuclear structure studies. In these collisions, we propose that the free spectator nucleons, which can be measured by zero-degree calorimeters, are clean probes of the neutron-skin thickness of the colliding nuclei. Based on the initial density distributions of typical nuclei calculated from the Skyrme-Hartree-Fock-Bogolyubov model, the information of spectator matter can be obtained from the Glauber model, and the free spectator nucleons are produced from a multi-fragmentation process from the spectator matter. In ultracentral collisions, these free spectator nucleons are most robust probes of the neutron skin, free from the uncertainty of the deexcitation process. In deformed nuclei, the neutron-skin thickness is also deformed, and in the case of axial symmetry its polar angular distribution is sensitive to the nuclear spin-orbit interaction as well as the neutron and proton numbers of the nucleus. We have further explored the possibility of probing the polar angular distribution of the neutron skin in colliding nuclei, by measuring the numbers of free spectator neutrons and protons in different collision configurations.

Summary

Contribution ID: **113** Type: **not specified**

The 184th HENPIC seminar by Prof. Tianbo Liu

Title: Spin 3/2 hadron: its polarization and fragmentation functions

Abstract: The spin, as a fundamental property of all particles, is proven a powerful quantity to test theories and models in hadron physics. The measurement of the polarization of a hadron produced in high energy scatterings provides an opportunity to understand the property of strong interaction. In this seminar, we will discuss the description of the polarization of a hadron, the spin density matrix of a spin-3/2 hadron, and the physical interpretation of the matrix elements. Then we provide a complete definition of quark fragmentation functions (FFs) to spin-3/2 hadrons from the decomposition of the quark-quark correlation matrix. As an application, we derive the differential cross section of the semi-inclusive electron-positron annihilation in terms of the newly defined FFs, which can also be applied in semi-inclusive deep inelastic scattering process for the study of nucleon structures.

Summary

Contribution ID: **114** Type: **not specified**

The 185th HENPIC seminar by Prof. Zhangbu Xu

Title: Quantum Entanglement Enabled Nuclear Tomography

Abstract: A linearly polarized photon can be quantized from the Lorentz-boosted electromagnetic field of a nucleus traveling at ultra-relativistic speed. When two relativistic heavy nuclei pass one another at a distance of a few nuclear radii, these photons from the two nuclei can interact with each other in the Breit-Wheeler process. I will discuss how the experimental measurements of the Breit-Wheeler process in ultra-relativistic heavy-ion collisions can be used to quantitatively measure the nuclear charge radius. The extracted parameters show potential centrality dependence, and can be used to study the initial charge fluctuation and final-state magnetic field effect in hadronic interactions. Conversely, photon from one nucleus may interact through a virtual quark-antiquark pair with gluons from the other nucleus forming a short-lived vector meson (e.g. ρ0). I will discuss how the polarization was utilized in diffractive photoproduction to observe a unique spin interference pattern in the angular distribution of ρ0⟶π+π− decays. The observed interference is a result of an overlap of two wave functions at a distance an order of magnitude larger than the ρ0 travel distance within its lifetime. The strong-interaction nuclear radii and neutron skins were extracted from these diffractive interactions. The observable is demonstrated to be sensitive to the nuclear geometry and quantum interference of non-identical particles. I will also discuss future experimental measurements and tests of quantum entanglement.

Summary

Contribution ID: **115** Type: **not specified**

The 186th HENPIC seminar by Dr. Yapeng Zhang

Title: Hypernuclei collective flow and its implication on the in-medium hyperon-nucleon interaction

Abstract: Hyperon-nucleon (YN) interaction is fundamentally important for exploring the nature of strong interaction. Density dependent YN and YNN interaction are essential inputs for understanding the inner structure of neutron stars. Heavy-ion collision is a unique tool to create dense nuclear matter in the laboratory. Collective flow has been commonly used for studying the properties of matter created in high-energy heavy-ion collisions. Collective flow of hypernuclei, bound state of hyperon(s) and nucleons, may shed light on YN interaction in condensed nuclear medium with finite pressure.

In this talk, I will report hypernuclei (_Λˆ3)H and (_Λˆ4)H reconstructions in √sNN=3 GeV mid-central Au+Au collisions at RHIC. Then, the first observation of the hyper-nuclei (_Λˆ3)H and (_Λˆ4)H directed flow v1 from 5–40% data sample will be presented. The directed flow of (_Λˆ3)H and (_Λˆ4)H are compared with those of the copiously produced particles such as p, Λ, d, t, 3He and 4He. It is observed that the slopes of v1 at mid-rapidity for the hyper-nuclei (_Λˆ3)H and (_Λˆ4)H follow a baryon number scaling implying that coalescence process is a dominant mechanism for the hyper-nuclei production in these collisions. The hypernuclei collective flow and its implication on the in-medium YN interaction will be discussed.

Summary

Contribution ID: **116** Type: **not specified**

The 187th HENPIC seminar by Prof. Jian Zhou

Title: High energy asymptotic behavior of gluon OAM

Abstract: Gluon generalized parton distribution (GPD) Eg plays an important role in nucleon sipn sum rules. In this talk, I will discuss the small-x evolution of gluon GPD Eg. We found that Eg at vanishing skewness exhibits the Regge behavior identical to the BFKL Pomeron despite its association with nucleon helicity-flip processes. We also consider the effect of gluon saturation and demonstrate that Eg gets saturated in the same way as its helicitynonflip counterpart Hg. Our result has a direct impact on the modeling of Eg as well as the small-x contribution to nucleon spin sum rules.

Summary

Contribution ID: **117** Type: **not specified**

The 188th HENPIC seminar by Prof. Xiaohui Liu

Title: Nucleon Energy Correlators

Abstract: Nucleon energy correlators are a class of new observables that measure the energy flow of particles out of the smashed nucleons or nucleus. In this talk, I will discuss their properties and demonstrate how they can be accessed at colliders. I will show examples how they could provide new insight into the nucleon/nucleus structures.

Summary

Contribution ID: **118** Type: **not specified**

The 189th HENPIC seminar by Dr. Weiyao Ke

Title: An extend range of sound dominance in the quark-gluon plasma

Abstract: The quark-gluon plasma (QGP) is a hot and dense state of matter governed by quantum chromodynamics (QCD). Like many other QCD systems, QGP displays different properties when probed at different scales. At long wavelengths (small gradients), phenomenological evidence suggests that it is a nearly perfect liquid; while at short distances, one expects to resolve quarks and gluons in the plasma. However, we know little about how the dynamics transit from hydrodynamic to microscopic excitations in the intermediate region. Recently, we noticed that in both weakly-coupled and strongly-coupled proxy theories of the QGP, sound dominance of the response persists at large wave numbers, way beyond the traditional hydrodynamic region. I will demonstrate how the Muller-Israel-Stewart hydrodynamics can be extended to describe such "sound dominance" at large gradients in the linear response limit. Finally, I will discuss possible phenomenological applications and implications.

Summary

Contribution ID: **119** Type: **not specified**

The 190th HENPIC seminar by Prof. Weizhi Xiong

Title: Current Status of Proton Charge Radius Puzzle

Abstract: The proton electric charge radius (rp) is an important quantity as it characterizes the spatial distribution of the proton's charge, and is also an essential physical input for the bound-state Quantum Electrodynamics calculations for the hydrogen atomic energy levels. In 2010, an unprecedentedly precise result was obtained using a novel muonic hydrogen spectroscopy technique. Nevertheless, this result triggered the "proton charge radius puzzle", as it was 7σ smaller than measurements from previous ep elastic scattering and ordinary hydrogen spectroscopy experiments. Despite tremendous experimental and theoretical progress since then, many issues remain unresolved, particularly in the lepton scattering field. In this talk, I will briefly review recent progress from lepton scattering experiments, with a focus on the high-precision proton charge radius experiment at Jefferson Lab (PRad). I will also introduce the recently approved PRad-II experiment, which aims to reduce the total uncertainty of rp by a factor of 4 compared to PRad. This new experiment will be able to push the precision frontier in electromagnetic interaction and contribute to new physics searches such as the violation of Lepton universality.

Summary

Contribution ID: **120** Type: **not specified**

The 191th HENPIC seminar by Prof. Shuzhe Shi

Title: Real-time non-perturbative dynamics of jet production: quantum entanglement and vacuum modification

Abstract: The production of jets should allow to test the real-time response of the QCD vacuum disturbed by the propagation of high-momentum color charges. Addressing this problem theoretically requires a real-time, non-perturbative method. As a step in developing such an approach, we report here on fully quantum simulations of a massive Schwinger model coupled to external sources representing quark and antiquark jets as produced in electron-positron annihilation. It is well known that the Schwinger model [QED in (1+1) dimensions] shares many common properties with QCD, including confinement, chiral symmetry breaking and the existence of vacuum fermion condensate. This allows us to study, for the first time, the modification of the vacuum chiral condensate by the propagating jets, and the quantum entanglement between the fragmenting jets. Our results indicate strong entanglement between the fragmentation products of the two jets at moderate rapidity separations that can potentially be studied in experiment. In this talk, I will also mention the application of quantum computation methods in studying phase structure and nonlinear wave propagation in Schwinger model. [ref: 2301.11991; see also 2305.00996, 2305.05685]

Summary

Contribution ID: **121** Type: **not specified**

The 192th HENPIC seminar by Dr. Shujie Li

Title: Nucleon-nucleon interactions at short distances

Abstract: Among the four known fundamental forces or interactions, gravitation and electromagnetism are close to daily life, while the strong and weak forces only reveal themselves at sub-atomic or smaller scales. The strong force, which is mediated by gluon exchange between quarks confines quarks into protons and neutrons (nucleons). The residual component of this strong force that induces the strong nuclear interactions between nucleons at the fermi scale (10ˆ-15m). This so-called "nuclear force" is attractive at a longer distance (e.g. for nucleon separation greater than the proton radius) and binds nucleons together into nuclei), while the force is strongly repulsive at a much shorter distance which prevents the nucleus from collapsing.

Nucleon interactions at short distances are not well-described in either QCD or the field theory. Experimentally, a series of electron-nucleon scattering measurements at Jefferson Lab (JLab) have determined about 20% of nucleons in heavy nuclei are moving fast (above the Fermi momentum) due to hard, short-distance interactions with another nucleons, forming so-called short-range correlated (SRC) pairs. Understanding those SRC pairs is necessary in providing a complete description of nuclear structure. It also offers us a unique chance to probe the tensor and repulsive force at intermediate to short distances. In this talk, I will present recent results from the JLab Hall A tritium program which studied the momentum distribution, and spin/isospin structure of SRC pairs in the mirror nuclei tritium and helium-3. I will then discuss how those measurements help us better understand the short-distance part of strong nucleon-nucleon interactions, and how the current and future measurements can push further by looking at the quark structure of small configurations.

Summary

Contribution ID: **122** Type: **not specified**

The 193th HENPIC seminar by Dr. Hai-Tao Li

Title: Heavy flavors on the lattice

Abstract: Heavy flavors, including heavy quarks and quarkonium (quark-antiquark bound states), are produced in the early stages of the ultra-relativistic heavy-ion collisions due to their large mass. Since they witness the entire evolution of the collisions, we can use them to probe the hot quark-gluon-plasma medium created in the collisions. By investigating the fate of the quarkonium we can infer the temperature of the hot medium. At high temperature quarkonium might dissociate and heavy quarks will be released from the bound states. After a certain a mount of time of traveling they get thermalized. The kinetic thermalization time of heavy quarks can be characterized by the heavy quark diffusion coefficient. In this talk I will report the lattice efforts in understanding the fate of quarkonium and the diffusion of heavy quarks in the hot medium.

Summary

Contribution ID: **123** Type: **not specified**

The 194th HENPIC seminar by Prof. Ian Moult

Title: Imaging the Intrinsic and Emergent Scales of QCD with Colliders

Abstract: The most powerful means of exploring nature at small length scales is through the use of particle colliders. Colliders smash particles together at high energies, briefly producing new particles through quantum fluctuations, which then decay into complicated sprays of energy in surrounding detectors. Much in analogy with how the details of our cosmic history are imprinted in the cosmic microwave background, the detailed features of the interactions of elementary particles are imprinted into macroscopic correlations in the energy flow of the collision products. Understanding the underlying microscopic physics in collider experiments therefore relies on our ability to decode these complicated correlations in energy flow. In turn, the desire to understand how to compute collider observables from an underlying quantum field theory (QFT) description has been a driver of theoretical developments and insights into the structure of QFT itself.

In this talk I will present some recent highlights in the quest to better understand the strong nuclear force at collider experiments, driven by recent theoretical developments in the understanding of a class of observables called “Energy Correlators” . I will then apply these developments to provide a new window on the dynamics of the Quark Gluon Plasma produced at collider experiments.

Summary