Quark Matter 2014 - XXIV International Conference on Ultrarelativistic Nucleus-Nucleus Collisions

List of Contributed Talks

http://indico.cern.ch/e/219436

Contribution ID : **4** Type : **Contributed Talk**

J/ψ production in Pb-Pb collisions at $\sqrt{s_{\rm NN}}$ = 2.76 TeV

Tuesday, 20 May 2014 09:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The ALICE Experiment at the Large Hadron Collider (LHC) provides unique capabilities to study charmonium production at low transverse momentum. In the early and hottest phase of nucleus-nucleus collisions the formation of a Quark-Gluon Plasma (QGP) is expected. Several QGP induced effects, such as the melting of charmonium states due to color screening and/or a (re)combination of uncorrelated charm and anti-charm quarks, can play a role. A suppression with respect to pp collisions of charmonium states such as the J/ψ was indeed observed in heavy-ion collisions, with the corresponding measurements in pp and p-Pb collisions being crucial for the understanding of the Pb–Pb results.

At central (forward) rapidity, corresponding to the range $|y| < 0.9$ ($2.5 < y < 4$) , J/ψ are reconstructed via their decay into two electrons (muons) down to zero transverse momentum ($p_{\rm T}$). We will present results on the inclusive J/ψ nuclear modification factor $R_{\rm AA}$ as a function of collision centrality, rapidity and transverse momentum p_\mathrm{T}, as well as results on the J/ψ $\langle p_{\rm T} \rangle$ in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV. Furthermore, a separation of prompt and non-prompt components is possible down to $p_{\rm T} = 1.3$ GeV/c at central rapidity and allows a determination of the $R_{\rm AA}$ of beauty hadrons and prompt J/ψ. These measurements provide, in combination with results from lower energies and theoretical predictions, detailed information on the different mechanisms related to the presence of the hot medium produced in heavy-ion collisions.

Primary author(s) : BOOK, Julian (Johann-Wolfgang-Goethe Univ. (DE))

Presenter(s) : BOOK, Julian (Johann-Wolfgang-Goethe Univ. (DE))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **15** Type : **Contributed Talk**

A unified picture of parton multiple scattering in the small-x regime and forward physics at RHIC and the LHC

Monday, 19 May 2014 17:50 (0:20)

On behalf of collaboration:

Abstract content

The quest for experimental signatures of small-x gluon saturation has been one of the major goals in p+A (d+A) programs at RHIC and LHC. Experimental measurements of single particle and two-particle correlations in the forward direction have revealed novel nuclear suppression patterns, which might help pinpoint the small-x gluon dynamics. At the moment there are two formalisms which can both describe reasonably well the nuclear suppression observed in these experiments. One is the so-called higher-twist factorization approach, which describes the parton multiple scattering in terms of the power corrections to the differential cross section [1,2]. The other one is the so-called small-x color glass condensate (CGC) approach [3]. So far the precise connection between these two approaches has not been established. In this talk, we demonstrate how the multiple parton scattering picture and the small-x gluon saturation picture are related and show how the transition from a dilute parton system to a dense gluon saturation region occurs. Our work unifies the two approaches in studying the nonlinear small-x parton dynamics. On the example of forward rapidity photon production in p+A collisions, we demonstrate that in the broad transition region between a dilute parton system and a deeply saturated regime the two approaches give identical results. This work also helps understand the constraints on the small-x phenomenological studies.
[1] J. Qiu and I. Vitev, Phys. Lett. B632, 507 (2006) [2] Z. B. Kang, I. Vitev and H. Xing, Phys. Rev. D85, 054024 (2012) [3] see, e.g., J. L. Albacete and C. Marquet, Phys. Rev. Lett. 105, 162301 (2010)

Primary author(s) : KANG, Zhongbo (L)

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Presenter(s) : KANG, Zhongbo (L)

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **20** Type : **Contributed Talk**

NLO transverse momentum broadening and QCD evolution of qhat

Wednesday, 21 May 2014 12:50 (0:20)

On behalf of collaboration:

Abstract content

There have been a lot of efforts focused on qualitative and quantitative studies of the properties of the sQGP through jet quenching. However, it is not clear whether the properties of the medium such as the jet transport parameter as probed by a propagating jet is unique and intrinsic to the medium, independent of the hard processes that produce the energetic jets. This is a problem of factorization of multiple scattering in QCD and so far has eluded many theoretical efforts. In this talk, we show you the first complete NLO calculation of transverse momentum broadening in SIDIS e+A and DY p+A collisions. We demonstrate for the first time how QCD factorization holds for multiple parton scattering and the universality of the associated quark-gluon correlation function or properties of nuclear matter contained therein as probed by a propagating parton, independent of the hard processes that create the fast partons. Our calculation also identifies the QCD evolution equation for this quark-gluon correlation function, which determines the QCD scale and jet energy dependence of the jet transport parameter. We further solve the QCD evolution equation of qhat numerically and determine the scale and energy dependence of the jet transport parameter in cold and hot dense medium.

Primary author(s) : XING, Hongxi (LANL)

Co-author(s) : Dr. KANG, Zhongbo (LANL); Dr. WANG, Enke (CCNU); WANG, Xin-Nian (Lawrence Berkeley National Lab. (US))

Presenter(s) : XING, Hongxi (LANL)

Session Classification : Jets

Track Classification : New Theoretical Developments

Contribution ID : **21** Type : **Contributed Talk**

Three loop HTL perturbation theory at finite temperature and chemical potential

Tuesday, 20 May 2014 11:10 (0:20)

On behalf of collaboration:

None

Abstract content

We present results of a three-loop hard-thermal-loop perturbation theory (HTLpt) calculation of the thermodynamic potential of a finite temperature and chemical potential system of quarks and gluons. We compare the resulting pressure, energy density, etc., and the diagonal/off-diagonal quark susceptibilities with lattice data. We show that there there is good agreement between the three-loop HTLpt analytic result and available lattice data.

Primary author(s) : STRICKLAND, Michael (Kent State University)

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Presenter(s) : STRICKLAND, Michael (Kent State University)

Session Classification : QCD at high temperature and/or density

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **23** Type : **Contributed Talk**

A scaling relation between proton-nucleus and nucleus-nucleus collisions

Monday, 19 May 2014 16:50 (0:20)

On behalf of collaboration:

Abstract content

I compare the flow-like correlations in high multiplicity proton-nucleus (p + A) and nucleus-nucleus (A + A) collisions. At fixed multiplicity, the correlations in these two colliding systems are strikingly similar, although though the system size in p + A is smaller. Based on an independent cluster model and a simple conformal scaling argument, where the ratio of the mean free path to the system size stays constant at fixed multiplicity, I argue that flow in p + A emerges as a collective response to the fluctuations in the position of the clusters, just like in A + A collisions. By examining the recent LHC data carefully, I show that this simple model captures the essential physics of elliptic and triangular flow in p + A collisions. I also explore the implications of the model for jet energy loss in p + A collisions.

Primary author(s) : Dr. BASAR, Gokce (Stony Brook University); Dr. TEANEY, Derek (Stony Brook University)

Presenter(s) : Dr. BASAR, Gokce (Stony Brook University)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **25** Type : **Contributed Talk**

Predictions for p+Pb collisions at $\sqrt{s_{NN}} = 5$ TeV: expectations vs. data

Tuesday, 20 May 2014 09:00 (0:20)

On behalf of collaboration:

JET

Abstract content

A compilation of predictions for charged hadron, identified light hadron, quarkonium, photon, jet and gauge boson production in p+Pb collisions at $\sqrt{s_{NN}} = 5$ TeV was made available ahead of the LHC p+Pb run [1]. We will compare the predictions to the available data and comment on the reliablity of the predictions.

[1] J. Albacete {\it et al.}, Int. J. Mod. Phys. E {\bf 22} (2013) 133007.

Primary author(s) : VOGT, Ramona (LLNL)

Presenter(s) : VOGT, Ramona (LLNL)

Session Classification : Jets

Track Classification : Initial State Physics

Contribution ID : **29** Type : **Contributed Talk**

Azimuthal jet tomography at RHIC and LHC

Tuesday, 20 May 2014 12:10 (0:20)

On behalf of collaboration:

None

Abstract content

Recent data on the azimuthal and transverse momentum dependence of high-pT pion nuclear modification factors and high-pT elliptic flow in nuclear collisions at RHIC and LHC are analyzed in terms of a generic dE/dx model that interpolates between running coupling pQCD-based models such as CUJET2.0 and AdS/CFT-inspired holographic models. The jet-energy loss models are coupled to state of the art viscous hydrodynamic fields. RHIC data are found to be surprisingly consistent with most dE/dx+Hydro models, but extrapolations to LHC energies favor running coupling QCD-based energy-loss models, while conformal holography models are inconsistent with the data. It is also shown that energy-loss fluctuations appear to play a crucial role in the underprediction of high-pT elliptic flow as seen by various pQCD-based energy-loss approximations.

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Presenter(s) : BETZ, Barbara (Frankfurt University)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **30** Type : **Contributed Talk**

Center Domains and Their Phenomenological Consequences in Ultrarelativistic Heavy Ion Collisions

Tuesday, 20 May 2014 11:10 (0:20)

On behalf of collaboration:

Abstract content

In this talk, we first argue that a domain structure, which can be inferred from the properties of the Polyakov loop and and is called center domains, is created in the deconfined QCD matter in the early stage of ultrarelativistic heavy ion collisions. Its formation is assisted by the gauge configuration in the glasma state created right after the collisions. Then we show that the center domains are an important facet of the evolution of the quark-gluon plasma from its birth up to hadronization. They naturally explain the strongly coupled nature of the quark gluon plasma including its major observed properties from its nearly ideal hydrodynamical behavior to strong jet quenching.

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Presenter(s) : ASAKAWA, Masayuki (Osaka University)

Session Classification : New theoretical developments

Track Classification : New Theoretical Developments

Contribution ID : **31** Type : **Contributed Talk**

Equilibration of anisotropic quark-gluon plasma produced by decays of color flux tubes

Monday, 19 May 2014 14:40 (0:20)

On behalf of collaboration:

Abstract content

A set of kinetic equations is used to study equilibration of the anisotropic quark-gluon plasma produced by decays of color flux tubes possibly created at the very early stages of ultra-relativistic heavy-ion collisions. The decay rates of the initial color fields are given by the Schwinger formula, and the collision terms are treated in the relaxation-time approximation. By connecting the relaxation time with viscosity we are able to study production and thermalization processes in the plasma characterized by different values of the ratio of the shear viscosity to entropy density, $\bar{\eta}$. For the lowest (KSS) value of this ratio, $4\pi\bar{\eta} = 1$, and realistic initial conditions for the fields, the system approaches the viscous-hydrodynamics regime within 1–2 fm/c. On the other hand, for larger values of the viscosity, $4\pi\bar{\eta} \geq 3$, the collisions in the plasma become inefficient to destroy collective phenomena which manifest themselves as oscillations of different plasma parameters. The presence of such oscillations brings in differences between the kinetic and hydrodynamic descriptions, which suggest that the viscous-hydrodynamics approach after 1–2 fm/c is not complete if $4\pi\bar{\eta} \geq 3$ and should be extended to include dissipative phenomena connected with color conductivity.
Presentation based on the article published as Phys. Rev. D88 (2013) 034028

Primary author(s) : FLORKOWSKI, Wojciech (Institute of nuclear Physics, Krakow)

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Session Classification : Approach to equilibrium

Track Classification : Approach to Equilibrium

Contribution ID : **32** Type : **Contributed Talk**

Zeroing in on the initial state - tomography combining bulk, jet and electromagnetic observables

Wednesday, 21 May 2014 11:50 (0:20)

On behalf of collaboration:

None

Abstract content

One of the unsolved problems in the current 'standard model' of heavy ion physics is the apparent rapid thermalization of QCD matter in the pre-equilibrium stage. While it is challenging to probe this mechanism directly, there are now several observables available which allow tomographic imaging of the initial state geometry, which is expected to carry remnant information of the equilibration mechanism. On the fluid dynamics side, scaled fluctuations in the momentum space anisotropy parameters v_n image the initial eccentricity fluctuations epsilon_n almost directly with only a weak dependence on fluid dynamics. From a different direction, due to the strong non-linear dependence of their emission rates on temperature, thermal photons and their v_n are very sensitive to the initial state graininess. Finally, the v_2 and v_3 of high P_T hadrons coming from hard processes reflect the attenuation pattern of partons propagating through the inhomogeneous matter density after some fluid dynamical evolution. Combining information from all these channels does not yet lead to a fully consistent picture, however intriguing trends pointing towards non-trivial initial state dynamics emerge. I review efforts to constrain the initial state by looking at all three classes of observables.

Primary author(s) : RENK, Thorsten (University of Jyväskylä)

Presenter(s) : RENK, Thorsten (University of Jyväskylä)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **33** Type : **Contributed Talk**

Magnetohydrodynamics, charged currents and directed flow in heavy ion collisions

Tuesday, 20 May 2014 11:30 (0:20)

On behalf of collaboration:

None

Abstract content

The hot QCD matter produced in any heavy ion collision with a nonzero impact parameter is produced within a strong magnetic field. We study the imprint that these fields leave on the azimuthal distributions and correlations of the produced charged hadrons. The magnetic field is time-dependent and the medium is expanding, which leads to the induction of charged currents due to the combination of Faraday and Hall effects. We find that these currents result in a charge-dependent directed flow v_1 that is odd in rapidity and odd under charge exchange. It can be detected by measuring correlations between the directed flow of charged hadrons at different rapidities, $\langle v_1^{\pm}(y_1)v_1^{\pm}(y_2)\rangle$

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Presenter(s) : GURSOY, Umut (University of Utrecht (NL))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **34** Type : **Contributed Talk**

Baseline for the energy dependence of higher moments of net-proton multiplicity distributions

Wednesday, 21 May 2014 11:50 (0:20)

On behalf of collaboration:

None

Abstract content

Experimental confirmation of the QCD critical point is an excellent test of QCD theory in the non-perturbative region and a milestone of exploring the QCD phase diagram. It is one of the main goals of the RHIC Beam Energy Scan (BES) program. Due to the high sensitivity to the correlation length [1] of the dynamical system and directly connected to the susceptibilities in theoretical calculations, for example, the Lattice Gauge Theory (LGT) calculations [2], higher moments of multiplicity distributions have been applied to search for the QCD critical point in the heavy-ion collision experiment.
To extract the CP signal in heavy-ion collisions, it is crucial to understand the non-CP effects, such as the effects of conservations for charges (electric, baryon number and strangeness number) and resonance decays, on the experimental observable. In this talk, we will present the comparison between baseline/model with recently published experimental results [3]. We will discuss the deviations of the data from Poisson, binomial baselines as well as the implications. In addition, the results from HRG, AMPT and UrQMD model will be compared with the experimental results.
[1] M. A. Stephanov, Phys. Rev. Lett. 102, 032301 (2009); Phys. Rev. Lett. 107, 052301 (2011); C. Athanasiou, et al., Phys. Rev. D 82, 074008 (2010). [2] S. Gupta, X. Luo, B. Mohanty, H. G. Ritter, N. Xu, Science 332, 1525 (2011); F. Karsch and K. Redlich, Phys. Lett. B 695, 136 (2011); A. Bazavov et al., Phys. Rev. Lett.,109, 192302 2012); S. Borsanyi et al., Phys. Rev. Lett.111, 062005 (2013). [3] STAR Collaboration, Phys. Rev. Lett. 112, 032302 (2014).

Primary author(s) : Dr. LUO, Xiaofeng (Central China Normal University)

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Presenter(s) : Dr. LUO, Xiaofeng (Central China Normal University)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **35** Type : **Contributed Talk**

Decoherence between the initial and final state radiation in a dense QCD medium

Monday, 19 May 2014 17:10 (0:20)

On behalf of collaboration:

None

Abstract content

We study medium modifications to the interference pattern between initial and final state radiation. We compute single gluon production off a highly energetic parton that undergoes a hard scattering and subsequently crosses a dense QCD medium of finite size. Multiple soft scatterings with the medium are resumed within the harmonic oscillator approximation. We find the decoherence of correlated partons traversing the medium depends on two scales: the medium length L and the decorrelation time of the gluon due to the medium τ_f. This interplay gives origin to two different asymptotic limits of the gluon spectrum: the coherent ($\tau_f \gg L$) and incoherent regime ($\tau_f \ll L$). We discuss the main characteristics of each regime. We show that in both cases there is a gradual onset of decoherence between the initial and final state radiation due to multiple scatterings, that opens the phase space for large angle emissions. By examining the multiplicity of produced gluons, we observe a potentially large double logarithmic enhancement for dense media and small opening angles. This result points to a possible modification of the evolution equations due to a QCD medium of finite size. We comment on the phenomenological consequences (such as radiative energy loss) of this setup in pA collisions.

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Presenter(s) : MARTINEZ GUERRERO, Mauricio (The Ohio State University)

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **41** Type : **Contributed Talk**

Turbulent thermalization process in heavy-ion collisions at ultrarelativistic energies

Monday, 19 May 2014 15:00 (0:20)

On behalf of collaboration:

Abstract content

When and to what extent a thermalized Quark Gluon Plasma is achieved in heavy-ion collision impacts the quantitative extraction of transport properties in the QGP. We address this problem by employing the largest to date real time classical-statistical lattice simulations. Most remarkably, we find that the thermalization process is governed by a universal attractor, where the space-time evolution of the plasma becomes independent of the initial conditions [1,2]. In this classical regime, the plasma exhibits the self-similar dynamics characteristic of wave turbulence, as observed in a large variety of strongly correlated many-body systems. We interpret the consequences of our numerical lattice results for thermalization in heavy-ion experiments.
[1] J.Berges,K.Boguslavski,S.Schlichting,R.Venugopalan; arXiv:1303.5650 [hep-ph]. [2] J.Berges,K.Boguslavski,S.Schlichting,R.Venugopalan; arXiv:1311.3005 [hep-ph].

Primary author(s) : Dr. SCHLICHTING, Sören (Brookhaven National Lab)

Co-author(s) : Prof. BERGES, Jürgen (Univ. Heidelberg); VENUGOPALAN, Raju (Brookhaven National Laboratory)

Presenter(s) : Dr. SCHLICHTING, Sören (Brookhaven National Lab)

Session Classification : Approach to equilibrium

Track Classification : Approach to Equilibrium

Contribution ID : **47** Type : **Contributed Talk**

Collisions in AdS: the road to experiments

Tuesday, 20 May 2014 11:50 (0:20)

On behalf of collaboration:

None

Abstract content

Holography has been used for a while as a strongly coupled approach to study the initial stage of heavy-ion collisions. As holographic calculations cannot directly describe QCD, importantly neglecting any weak-coupling effects, it is an interesting question how well these studies fit experimental data. Here, we will focus on longitudinal dynamics, modeled by colliding shock waves in AdS.

These collisions give a surprisingly universal rapidity profile, where the shape at high collision energies is completely independent of the energy or longitudinal structure of the colliding shocks. It is somewhat complicated to compare this initial profile to the final measured rapidity profile, but we can compute the entropy and thereby make an estimate of the total multiplicity. The result indicates that our infinite coupling profile has somewhat more stopping than in real heavy-ion collisions, which is most likely because of neglecting weak-coupling effects. We finally comment on (future) consequences for real nucleus-nucleus and proton-nucleus collisions.

References: arxiv:1312.2956 and 1305.4919 (PRL 111)

Primary author(s) : VAN DER SCHEE, Wilke (Utrecht University); CASALDERREY SOLANA, Jorge (University of Barcelona (ES)); HELLER, Michal P. (Universiteit van Amsterdam); MATEOS, David (ICREA & U. Barcelona)

Presenter(s) : VAN DER SCHEE, Wilke (Utrecht University)

Session Classification : New theoretical developments

Track Classification : New Theoretical Developments

Contribution ID : **48** Type : **Contributed Talk**

Soft photon production from real-time dynamics of jet fragmentation

Monday, 19 May 2014 16:50 (0:20)

On behalf of collaboration:

None

Abstract content

Soft photons produced in heavy ion collisions are an important tool in probing the properties of the quark-gluon plasma. For this purpose, it is crucial to understand the background - soft photons produced in elementary collisions. Low theorem states that soft photon production in hadron collisions is dominated by Bremsstrahlung off charged initial and final state hadrons. Surprisingly, almost every experiment observed an enhancement (by a factor of $2 \div 5$) above Low theorem's prediction. This is the longstanding puzzle of "anomalous soft photon production." The phenomenon is not observed in processes with leptonic final states, which suggests that the mechanism is due to nonperturbative QCD evolution. We study this phenomenon using an exactly soluble, massless, Abelian model in $1 + 1$ dimensions which shares with QCD many important properties: confinement, chiral symmetry breaking, axial anomaly and θ-vacuum. We then apply this model to the soft photon production in the fragmentation of jets produced in Z^0 decays and find a qualitative agreement with the data.

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Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **50** Type : **Contributed Talk**

Jet propagation within a Linearized Boltzmann Transport Model

Wednesday, 21 May 2014 10:00 (0:20)

On behalf of collaboration:

JET

Abstract content

A Linearized Boltzmann Transport model is developed for the study of parton propagation inside quark-gluon plasma. The leading partons, thermal recoiled partons and radiated gluons are all tracked so that one can also study jet-induced medium excitation. In this study, we implement the complete set of elastic parton scattering processes and investigate parton energy loss, transverse momentum broadening and their nontrivial energy and length dependence. We further investigate the jet shape and fragmentation functions of reconstructed jets using FASTJET algorithm. Contributions from the recoiled thermal partons are found to have significant influences on jet shape and angular distribution of reconstructed jets.

Primary author(s) : Mr. LUO, Tan (Central China Normal University); Prof. WANG, Xin-Nian (CCNU/LBNL)

Presenter(s) : Mr. LUO, Tan (Central China Normal University)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **51** Type : **Contributed Talk**

Qualitative extraction of qhat from combined jet quenching at RHIC and LHC

Tuesday, 20 May 2014 11:50 (0:20)

On behalf of collaboration:

JET

Abstract content

On behalf the JET Collaboration
Within five different approaches to parton propagation and energy loss in dense matter, a phenomenological study of experimental data on suppression of large p_T single inclusive hadrons in heavy-ion collisions at both RHIC and LHC was carried out. The evolution of bulk medium used in the study for parton propagation was given by 2+1D or 3+1D hydrodynamic models which are also constrained by experimental data on bulk hadron spectra. Values for the jet transport parameter $\hat{q}$ at the center of the most central heavy-ion collisions are extracted or calculated within each model, with parameters for the medium properties that are constrained by experimental data on the hadron suppression factor R_{AA}. For a quark with initial energy of 10 GeV we find that $\hat{q} \approx 1.2 \pm 0.3$ GeV^2/fm at an initial time $\tau_0 = 0.6$ fm/c in Au+Au collisions at $\sqrt{s} = 200$ GeV/n and $\hat{q} \approx 1.9 \pm 0.7$ GeV^2/fm in Pb+Pb collisions at $\sqrt{s} = 2.76$ TeV/n. Compared to earlier studies, these represent significant convergence on values of the extracted jet transport parameter, reflecting recent advances in theory and the availability of new experiment data from the LHC.

Primary author(s) : JET, Collaboration (Presenter TBD)

Presenter(s) : WANG, Xin-Nian (Central China Normal University/Lawrence Berkeley National Lab)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **53** Type : **Contributed Talk**

Heavy-flavor evolution in QGP and hadron gas: suppression, flow and angular de-correlation

Monday, 19 May 2014 16:50 (0:20)

On behalf of collaboration:

None

Abstract content

Heavy flavor hadrons serve as valuable probes of the transport properties of the quark-gluon plasma (QGP) created in relativistic heavy-ion collisions. We introduce a comprehensive framework that describes their full-time evolution in the QGP matter and the subsequent hadronic phase. The heavy quark energy loss in a de-confined QCD medium is modeled with our improved Langevin approach [1] that simultaneously incorporates quasi-elastic scattering [2,3] and medium-induced gluon radiation [4]. The subsequent transport of heavy mesons in the hadron gas phase is described within the ultra-relativistic quantum molecular dynamics (UrQMD) model [5]. The intermediate hadronization process from heavy quarks to their respective mesonic bound states is calculated with our hybrid fragmentation plus coalescence model [1].

We investigate the relative contribution of each of these ingredients to the final-state spectra of heavy mesons and demonstrate that while quasi-elastic scattering dominates heavy quark energy loss in the QGP at low energies, contributions from gluon radiation at high energies are significant; the coalescence process is found important for heavy meson production at intermediate transverse momenta; and the subsequent hadronic interactions is equally crucial as the free quark evolution inside QGP for the development of heavy flavor suppression and collective flow behaviors that one observes. Within this newly developed framework, we provide a good description of D meson suppression and flow measured at both RHIC and LHC, as well as predictions for the future measurements of B mesons.

In addition, a new set of observables – heavy-flavor-tagged angular correlation functions – are explored and found to be potential candidates for distinguishing different energy loss mechanisms of heavy quarks inside a QGP medium [6]. We calculate correlation functions for D-D, D-e, D-hadron, e-hadron, etc., some of which can be compared to the existing preliminary data from LHC experiments.

1. S. Cao, G.-Y. Qin, and S. A. Bass, Phys. Rev. C88, 044907 (2013).
2. G. D. Moore and D. Teaney, Phys. Rev. C71, 064904 (2005).
3. S. Cao and S. A. Bass, Phys. Rev. C84, 064902 (2011).
4. B.-W. Zhang, E. Wang, and X.-N. Wang, Phys. Rev. Lett. 93, 072301 (2004).
5. S. A. Bass, et al., Prog. Part. Nucl. Phys. 41, 255-369 (1998).
6. S. Cao, G.-Y. Qin, S. A. Bass and B. Mueller, J. Phys. Conf. Ser. 446, 012035 (2013).

Primary author(s) : CAO, Shanshan (Duke University); QIN, Guang-You (Central China Normal University); Prof. BASS, Steffen A. (Duke University)

Presenter(s) : CAO, Shanshan (Duke University)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **55** Type : **Contributed Talk**

Charmonium suppression in a hot medium: melting vs absorption

Tuesday, 20 May 2014 10:00 (0:20)

On behalf of collaboration:

None

Abstract content

A colorless $c\bar{c}$ dipole propagating through a hot medium can be dissolved either due to Debye screening of the binding potential, or by inelastic (color exchange) interaction with the medium, which turns the dipole into a color-octet state (absorption). Both mechanisms are included into the path-integral description of the in-medium propagation of the dipole, providing the real and imaginary parts of the light-cone potential respectively. We found that absorption, which is frequently forgotten, leads to a considerably stronger suppression of J/Ψ production in heavy ion collisions, than the effect of Debye screening.

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Presenter(s) : KOPELIOVICH, Boris (UTFSM)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **58** Type : **Contributed Talk**

Hot and dense quark matter at large number of colors and flavors

Monday, 19 May 2014 18:10 (0:20)

On behalf of collaboration:

None

Abstract content

I will discuss a holographic model of finite temperature and density QCD matter with a large and roughly equal number of colors and flavours. The basic framework of the model is 5-dimensional classical Einstein gravity with a black hole and with an AdS_5 boundary, on which the physical 4-dimensional quantum theory resides. The model further contains a scalar dilaton for asymptotic freedom and confinement, a scalar tachyon for chiral symmetry breaking and a charge density for chemical potential. Solving the classical gravity equations numerically leads to an identification of a chirally symmetric and chirally broken phase with a phase transition in between. The phase transition line on the T, μ plane can have both 2nd and 1st order segments. The computation can be extended down to the quantum phase transition at $T = 0$. The dilaton and tachyon potentials are only constrained by physical properties, not uniquely determined. Until they are derived one cannot make definite predictions, the model rather is a framework for discussing various dynamical alternatives.

Primary author(s) : Prof. KAJANTIE, Keijo (Helsinki Institute of Physics)

Presenter(s) : Prof. KAJANTIE, Keijo (Helsinki Institute of Physics)

Session Classification : Heavy flavor

Track Classification : New Theoretical Developments

Contribution ID : **60** Type : **Contributed Talk**

Dijets in p+Pb collisions and their quantitative constraints for nuclear PDFs

Monday, 19 May 2014 18:10 (0:20)

On behalf of collaboration:

None

Abstract content

We present a perturbative QCD analysis concerning the production of high-pT dijets in p+Pb collisions at the LHC. The next-to-leading order corrections, scale variations and free-proton PDF uncertainties are found to have only a relatively small influence on the normalized dijet rapidity distributions. Interestingly, however, these novel observables prove to retain substantial sensitivity to the nuclear effects in the PDFs. Especially, they serve as a more robust probe of the nuclear gluon densities at $x > 0.01$, than e.g. the inclusive hadron production. We confront our calculations with the recent data by the CMS collaboration. These preliminary data lend striking support to the gluon antishadowing similar to that in the EPS09 nuclear PDFs.

Primary author(s) : Dr. PAUKKUNEN, Hannu (University of Jyväskylä)

Co-author(s) : ESKOLA, Kari J. (University of Jyvaskyla); SALGADO LOPEZ, Carlos Albert (Universidade de Santiago de Compostela (ES))

Presenter(s) : Dr. PAUKKUNEN, Hannu (University of Jyväskylä)

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **61** Type : **Contributed Talk**

Collective flow in small systems

Monday, 19 May 2014 11:40 (0:20)

On behalf of collaboration:

None

Abstract content

The collective expansion of the fireball formed in ultrarelativistic p-A and d-A collisions are discussed. Estimates based on the extrapolation of the hydrodynamic model from A-A collisions to small systems indicate possible formation of a dense droplet of matter. Fluctuation in the initial state lead to finite eccentricity and triangularity, which give measurable elliptic and triangular flow of the emitted particles. Further predictions consistent with experimental observations are the mass ordering of the average transverse momentum and of the elliptic flow for identified particles. We discuss the prediction of the model for collisions of a deformed projectile as in d-A collisions. This deformation leads to a large elliptic flow.

Primary author(s) : BOZEK, Piotr

Co-author(s) : BRONIOWSKI, Wojciech (IFJ PAN)

Presenter(s) : BOZEK, Piotr

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **80** Type : **Contributed Talk**

Extracting the bulk viscosity of the quark-gluon plasma

Monday, 19 May 2014 15:40 (0:25)

On behalf of collaboration:

None

Abstract content

Currently, most fluid-dynamical simulations of relativistic heavy ion collisions take into account only dissipative effects originating from shear viscosity. However, there is no a priori reason to neglect bulk viscosity since the actual order of magnitude and temperature dependence of this transport coefficient is unknown, and could be significant. In this work, we explore the phenomenological implications of a nonzero bulk viscosity coefficient on transverse momentum spectra and azimuthal momentum anisotropy. We then extract the optimal values of the bulk and shear viscosity coefficients that are able to describe these observables. For ultracentral heavy ion collisions, measured by ATLAS and CMS, we perform this analysis using several initial condition models. For other centrality classes, we determine these coefficients using the IP-Glasma initial condition model. Our fluid-dynamical description is the most complete available and includes all possible second order terms that appear in Israel-Stewart theory, including those that couple bulk viscous pressure to shear stress. The transport coefficients of all terms are computed using kinetic theory. We find that the optimum values of shear viscosity extracted from data can be modified up to 50% when bulk viscosity is included.

We further discuss the effects of baryon chemical potential on the shear viscosity of bulk nuclear matter. We show that a hadron resonance gas with large baryon number density is closer to the ideal fluid limit than the corresponding gas with zero baryon number.

Primary author(s) : JEON, Sangyong (McGill University); GALE, Charles (McGill University); Dr. SCHENKE, Bjoern (Brookhaven National Lab); PAQUET, Jean-Francois (McGill University); Dr. DENICOL, Gabriel (McGill University); ROSE, Jean-Bernard (McGill); LUZUM, Matthew (McGill University)

Presenter(s) : Dr. DENICOL, Gabriel (McGill University)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **81** Type : **Contributed Talk**

Relating classical strings and gravitons in AdS/CFT jet quenching

Tuesday, 20 May 2014 12:30 (0:20)

On behalf of collaboration:

None

Abstract content

Here's a fun question in gravity: What happens when a high-momentum graviton falls into a large (AdS-)black hole? Answer: Tidal forces outside the black hole can stretch the graviton from a quantum string into a large, classical string. What does this have to do with theory investigations related to jet quenching in strongly coupled plasmas? It provides a link between two very different methods that have been used to set up "jet stopping" problems in such plasmas—methods which have given parametrically different results.

Primary author(s) : ARNOLD, Peter (University of Virginia)

Co-author(s) : Prof. VAMAN, Diana (University of Virginia); Dr. SZEPIETOWSKI, Phillip (University of Virginia); Mr. WONG, Gabriel (University of Virginia)

Presenter(s) : ARNOLD, Peter (University of Virginia)

Session Classification : New theoretical developments

Track Classification : New Theoretical Developments

Contribution ID : **82** Type : **Contributed Talk**

The ridge through Colored Glass

Monday, 19 May 2014 11:00 (0:20)

On behalf of collaboration:

None

Abstract content

The ridge in pp, p/d+A and A+A collisions manifest at very high multiplicities. Regardless of whether initial state or final state effects dominate, the physics of very high parton densities is relevant. In this talk, we attempt a synthesis of the state-of-the art in the CGC approach to computing both initial state and final state effects that generate collimated long range rapidity correlations. The emphasis throughout will be on a) quantitative comparisons to data, and b) on open problems in the different approaches that become manifest through such comparisons. We will discuss future measurements that are likely to provide definitive answers regarding the physics underlying this remarkable phenomenon.
References: 1) K. Dusling and R. Venugopalan, Initial state triangular azimuthal anisotropy in p+A and A+A collisions",in preparation. 2) B. Schenke, P. Tribedy, and R. Venugopalan,Multiplicity constrained v_n moments in pA and AA collisions in the IP-Glasma model", in preparation. 3) B.˜ Schenke, P. Tribedy and R. Venugopalan, Multiplicity distributions in p+p, p+A and A+A collisions from Yang-Mills dynamics," Phys.\ Rev.\ C {\bf 89}, 024901 (2014). 4)A. Bzdak, B. Schenke, P. Tribedy and R. Venugopalan,Initial state geometry and the role of hydrodynamics in proton-proton, proton-nucleus and deuteron-nucleus collisions,"Phys.\ Rev.\ C {\bf 87}, 064906 (2013).

Primary author(s) : VENUGOPALAN, Raju

Presenter(s) : VENUGOPALAN, Raju

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **85** Type : **Contributed Talk**

Dielectron measurements in pp, p-Pb and Pb-Pb collisions with ALICE at the LHC

Monday, 19 May 2014 11:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Electromagnetic probes are excellent messengers from the hot and dense medium created in ultra-relativistic heavy-ion collisions. Since leptons do not interact strongly, their spectra reflect the entire space-time evolution of a collision. The surrounding medium can lead to modifications of the dielectron production rate. To quantify modifications in heavy-ion collisions, measurements in pp collisions serve as a reference, while the analysis of p-A collisions allows to disentangle cold from hot nuclear matter effects.

We present dielectron measurements with the ALICE central barrel detectors. The invariant mass distributions in the range $0 < m_{ee} < 3$ GeV/c^2 are compared to the expected hadronic sources for pp collisions at $\sqrt{s} = 7$ TeV, and for p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV. The cross section of virtual direct photons measured in pp collisions is compared to predictions from NLO calculations as a function of the transverse momentum. Latest results of the analysis of Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV are presented.

Primary author(s) : KOHLER, Markus (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Presenter(s) : KOHLER, Markus (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **89** Type : **Contributed Talk**

Upsilon production as a probe of the early state in heavy ion collisions

Wednesday, 21 May 2014 10:20 (0:20)

On behalf of collaboration:

None

Abstract content

Upsilon production in heavy ion collisions at RHIC and LHC is investigated. While the transverse momentum spectra of the ground state Upsilon(1s) are controlled by the initial state Cronin effect, the excited states are characterized by the competition between the cold and hot nuclear matter effects and sensitive to the dissociation temperatures determined by the heavy quark potential. We emphasize that it is necessary to measure the excited heavy quark states in order to extract the early stage information in high energy nuclear collisions.

Primary author(s) : Prof. ZHUANG, Pengfei (Tsinghua University)

Co-author(s) : Mr. ZHOU, Kai (Tsinghua University); Dr. XU, Nu (LBNL)

Presenter(s) : Prof. ZHUANG, Pengfei (Tsinghua University)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **93** Type : **Contributed Talk**

Jet quenching from the lattice

Tuesday, 20 May 2014 11:10 (0:20)

On behalf of collaboration:

None

Abstract content

We present a lattice study of the momentum broadening experienced by a hard parton in the quark-gluon plasma. In particular, the contributions to this real-time phenomenon from soft modes are extracted from a set of gauge-invariant operators in a dimensionally reduced effective theory (electrostatic QCD), which can be simulated on a Euclidean lattice. At the temperatures accessible to present experiments, the soft contributions to the jet quenching parameter are found to be quite large. We compare our results to phenomenological models and to holographic computations.

Primary author(s) : PANERO, Marco (IFT UAM/CSIC)

Co-author(s) : RUMMUKAINEN, Kari (University of Helsinki); SCHÄFER, Andreas (University of Regensburg)

Presenter(s) : PANERO, Marco (IFT UAM/CSIC)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **94** Type : **Contributed Talk**

Heavy-flavour production and nuclear modification factor in Pb-Pb collisions at $\sqrt{s_{\rm NN}}$ =2.76 TeV with ALICE

Monday, 19 May 2014 11:40 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Heavy quarks (charm and beauty) are considered effective probes to investigate the properties of the strongly-interacting medium formed in high energy nuclear collisions. Heavy quarks lose energy interacting with the medium via inelastic processes (medium-induced gluon radiation) and elastic collisions. The nuclear modification factor, $R_{\rm AA}$, defined as the ratio of the heavy-flavour production yield in nucleus-nucleus collisions to the binary scaled pp one, is an observable sensitive to in-medium energy loss. In particular, the comparison of the $R_{\rm AA}$ of charm, beauty and light-flavour hadrons provides information about the colour charge and parton mass dependence of the energy loss. Open heavy-flavour production was measured with ALICE in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV using D mesons ($\rm D^0$, $\rm D^{*+}$, $\rm D^+$ and $\rm D_s^+$) reconstructed from their hadronic decays and electrons from heavy-flavour decays at central rapidity, and muons from heavy-flavour decays at forward rapidity. The D meson and heavy-flavour decay leptons differential $R_{\rm AA}$ measurements, namely the transverse momentum, rapidity and centrality dependence, will be shown. The comparison of the nuclear modification factors of strange and non-strange D mesons will be presented, as well as the $\rm D^0$ $R_{\rm AA}$ measured in different azimuthal regions with respect to the reaction plane of the collision. The D meson $R_{\rm AA}$ will be compared with light-flavour and non-prompt $\rm J/\psi$ results (from the CMS experiment). In addition, the heavy-flavour $R_{\rm AA}$ and v_2 will be compared to results from Au-Au collisions at $\sqrt{s_{\rm NN}} = 200$ GeV measured at RHIC. Finally, the heavy-flavour measurements will be compared to theoretical models.

Primary author(s) : FESTANTI, Andrea (Universita e INFN (IT))

Presenter(s) : FESTANTI, Andrea (Universita e INFN (IT))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **95** Type : **Contributed Talk**

Locating the CEP

Tuesday, 20 May 2014 14:40 (0:20)

On behalf of collaboration:

None

Abstract content

I review resent results on the chiral and deconfinement transitions of QCD and the associated phase diagram obtained from a combination of lattice results with the framework of Dyson-Schwinger equations. At zero chemical potential we find excellent agreement with existing lattice results. We discuss the potential location of the critical endpoint for Nf=2+1 and Nf=2+1+1 flavors and present first results for the Polyakov potential at finite chemical potential.

Primary author(s) : Prof. FISCHER, Christian (JLU Giessen)

Presenter(s) : Prof. FISCHER, Christian (JLU Giessen)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **110** Type : **Contributed Talk**

Viscous hydrodynamics for systems undergoing strongly anisotropic expansion

Monday, 19 May 2014 15:20 (0:20)

On behalf of collaboration:

JET

Abstract content

The collective expansion in relativistic heavy-ion collisions is initially highly anisotropic. Due to viscosity, this leads to strongly deformed local momentum distributions which invalidates the standard viscous hydrodynamic expansion around a local equilibrium distribution, causing a breakdown of viscous fluid dynamics à la Israel and Stewart at early times. We have developed an improved formulation of viscous hydrodynamics [1] that is based on an expansion around a spheroidally deformed local momentum distribution. A spheroidal local momentum distribution leads to the "anisotropic hydrodynamics" developed earlier by Martinez and Strickland, which accounts non-perturbatively for the resulting large early-time anisotropy between the longitudinal and transverse pressures. By allowing in our new treatment for additional small deviations of the local momentum distribution from spheroidal symmetry, we arrive at a complete formulation of second-order viscous hydrodynamics in which the large longitudinal-transverse momentum anisotropy is treated non-perturbatively à la Martinez and Strickland while the smaller remaining viscous stress components are treated perturbatively à la Israel and Stewart. We perform a test of the approach for a system undergoing boost-invariant longitudinal expansion without transverse expansion which maximizes the longitudinal-transverse pressure anisotropy. For this system the Boltzmann equation can be solved exactly in the relaxation-time approximation, allowing for a quantitative test of effective macroscopic hydrodynamic theories. We find that the viscous anisotropic hydrodynamic framework ("vaHydro") significantly outperforms all other available hydrodynamic descriptions, for both small and large values of the shear viscosity η/s. We expect vaHydro to provide a superior description also after including transverse expansion and to allow for an earlier matching of pre-equilibrium dynamics to hydrodynamics, due to the superior ability of vaHydro to handle the large differences in longitudinal and transverse expansion rates at early times.
[1] D. Bazow, U. Heinz, M. Strickland, arXiv:1311.6720, Phys. Rev. C, in press.

Primary author(s) : HEINZ, Ulrich (The Ohio State University)

Co-author(s) : STRICKLAND, Michael (Kent State University); Mr. BAZOW, Dennis (The Ohio State University)

Presenter(s) : HEINZ, Ulrich (The Ohio State University)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **122** Type : **Contributed Talk**

Heavy-flavour elliptic flow in Pb-Pb collisions at $\sqrt{s_{\rm NN}}$ = 2.76 TeV measured with ALICE at the LHC

Monday, 19 May 2014 12:40 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The main purpose of ALICE at the LHC is to investigate the properties of the deconfined state of strongly-interacting matter produced in high-energy heavy-ion collisions. Since heavy quarks, i.e. charm and beauty, are produced on a shorter time scale with respect to the hot fireball, they are suited to probe the interaction dynamics inside the medium.
The ALICE collaboration has measured the production of open heavy-flavour hadrons via their hadronic and semi-electronic decays at mid-rapidity and via the semi-muonic decay channel at forward rapidity in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV. The azimuthal distribution of heavy-flavour hadrons reflects the initial spatial anisotropy of the heavy-ion collision in case of sufficient re-scattering of the heavy quarks in the hot and dense matter. Therefore the heavy-flavour elliptic flow, the second harmonic in the Fourier expansion of the particle azimuthal distribution, is an observable sensitive to the degree of thermalization of charm and beauty quarks in the medium at low $p_{\rm T}$, as well as to the path length dependence of the energy loss of heavy quarks at high $p_{\rm T}$.
The elliptic flow measurements are presented for prompt charm mesons, i.e $\rm D^0$, $\rm D^+$, $\rm D^{*+}$, and heavy-flavour decay electrons at mid-rapidity, as well as for heavy-flavour decay muons at forward rapidity in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV for various centrality intervals. The results will be compared with corresponding measurements of other hadron species. Results of the D-meson nuclear modification factor measured in the direction of the reaction plane and orthogonal to it will be also shown. Comparisons with model calculations will be discussed.

Primary author(s) : BAILHACHE, Raphaelle (Johann-Wolfgang-Goethe Univ. (DE))

Presenter(s) : BAILHACHE, Raphaelle (Johann-Wolfgang-Goethe Univ. (DE))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **123** Type : **Contributed Talk**

Measurements of the heavy-flavour nuclear modification factor in p-Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with ALICE at the LHC

Monday, 19 May 2014 15:00 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The LHC heavy-ion physics program aims at investigating the properties of strongly interacting matter at extreme conditions of temperature and energy density, where the formation of the Quark-Gluon Plasma (QGP) is expected. In high-energy heavy-ion collisions, heavy quarks are regarded as effective probes of the properties of the QGP as they are created on a short time scale, with respect to that of the QGP, and subsequently interact with it. The nuclear modification factor $R_{\rm AA}$, defined as the ratio of the yield measured in Pb-Pb to that observed in pp collisions scaled with the number of binary nucleon-nucleon collisions, is used to study the mechanisms of heavy quark in-medium energy loss and hadronization. In order to disantangle hot and cold nuclear matter effects, the nuclear modification factor was measured in p-Pb collisions where the formation of a large volume hot and dense medium is not expected. Heavy-flavour production in p-Pb collisions has also its own interest since it allows us to investigate initial state effects such as modifications of the parton distribution functions in the nucleus, gluon saturation and $k_{\rm T}$ broadening.

With ALICE, the detector designed and optimized for heavy-ion physics at the LHC, open heavy flavours are measured at central rapidity using using their hadronic and semi-electronic decays as well as at forward and backward rapidity using their semi-muonic decays. The latest results on the nuclear modification factor of charmed mesons and electrons and muons from heavy-flavour hadron decays in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV will be presented. Comparisons with theoretical predictions will be discussed.

Primary author(s) : LI, Shuang (Univ. Blaise Pascal Clermont-Fe. II (FR))

Presenter(s) : LI, Shuang (Univ. Blaise Pascal Clermont-Fe. II (FR))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **124** Type : **Contributed Talk**

Heavy-flavour correlations in pp, p-Pb and Pb-Pb collisions

Monday, 19 May 2014 16:30 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Heavy quarks (charm and beauty) are excellent probes to study the properties of the strongly interacting matter formed in heavy ion collisions, which is expected to be a Quark-Gluon Plasma (QGP). Indeed, due to their large mass, charm and beauty quarks are produced in initial hard scattering processes among partons of the colliding nuclei, before the formation of the QGP, and they traverse the medium and interact with its constituents. The ALICE Collaboration measured the production of open heavy-flavour hadrons via their hadronic and semi-leptonic decays at mid-rapidity in pp, p-Pb and Pb-Pb collisions at $\sqrt{s_{NN}} = 7$, 5.02 and 2.76 TeV respectively. A strong suppression of the open charm hadron yields at high p_{T} was observed in Pb-Pb collisions relative to pp interactions: this effect is attributed to a substantial in-medium energy loss of the charm quarks. Further insight into the effects of the medium on charm and beauty quarks can be obtained by measuring the angular correlations between open heavy-flavour hadrons and charged hadrons. The comparison of the correlation function in pp and Pb-Pb collisions can provide deeper information on the way heavy quarks lose energy in the QGP and can spot possible modifications to the charm parton shower and hadronisation in the presence of the medium. Furthermore, by studying the correlations of electrons from heavy-flavour decays and the charged hadrons in pp, it is possible to statistically separate the charm and beauty contributions to the yield of heavy-flavour decay electrons, making this analysis an excellent tool to test pQCD calculations. The observation of double-ridge long range correlations in p-Pb collisions for light-flavour hadrons could originate from a collective behaviour of the system, as well as from gluon saturation in the initial state (color glass condensate). The same effect can be studied for heavier quarks via the correlation between heavy-flavour hadrons (or their decay electrons) and charged particles. Results from the correlation analyses, performed using the data collected with ALICE in pp collisions at $\sqrt{s} = 7$ TeV, Pb-Pb at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV, and in p-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV will be presented in this contribution.

Primary author(s) : BJELOGRLIC, Sandro (NIKHEF (NL))

Presenter(s) : BJELOGRLIC, Sandro (NIKHEF (NL))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **134** Type : **Contributed Talk**

ϒ production in hadronic collisions with ALICE at the LHC

Wednesday, 21 May 2014 10:00 (0:20)

On behalf of collaboration:

ALICE

Abstract content

ALICE is the LHC experiment devoted to the study of heavy-ion collisions. The main purpose of ALICE is to investigate the properties of the deconfined state of nuclear matter, the Quark-Gluon Plasma (QGP). Quarkonium measurements play a crucial role in this investigation. In particular, the sequential suppression of the quarkonium states by colour screening has long been suggested as a signature and thermometer of the QGP. The first results on quarkonium suppression in Pb-Pb collisions at the LHC seem to indicate that for charmonia both regeneration and colour screening mechanisms play a role while for bottomonia the regeneration mechanism should be small. Initial state effects can play a role in bottomonium production in Pb-Pb collisions and thus should be studied using proton-nucleus collisions, where no deconfined state is expected to be created. ϒ production can be measured in ALICE in the dimuon decay channel using the forward muon spectrometer. We will present the latest results on ϒ production in pp, p-Pb and Pb-Pb collisions at LHC energies measured by the ALICE experiment at forward-rapidity.

Primary author(s) : CASTILLO CASTELLANOS, Javier (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Presenter(s) : CASTILLO CASTELLANOS, Javier (CEA/IRFU,Centre d'etude de Saclay Gif-sur-Yvette (FR))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **135** Type : **Contributed Talk**

J/ψ production in p-Pb collisions with ALICE at the LHC

Tuesday, 20 May 2014 14:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The study of charmonium production, bound states of c and $\bar{c}$ quarks, is an intense research activity, both experimentally and theoretically. The peculiar properties of some of the charmonium states, like their small size (< 1 fm) and strong binding energy (several hundred MeV), make them ideal probes of the strongly interacting matter, the so-called Quark-Gluon Plasma (QGP), produced in high-energy heavy-ion collisions.
ALICE is dedicated to the study of QGP properties in heavy-ion collisions at the LHC. A suppression of the J/ψ has been found in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV, with respect to the J/ψ measured in pp collisions at the same center-of-mass energy. At the beginning of 2013, p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV have been studied at the LHC, in order to measure the effects related to cold nuclear matter, which, for charmonia, include gluon shadowing (or gluon saturation), energy loss and nuclear absorption. The study of these effects in p-Pb collisions is important in order to be able to disentangle hot and cold nuclear matter effects in Pb-Pb collisions.
The obtained results on the J/ψ production and nuclear modification factor as a function of rapidity or transverse momentum in p-Pb collisions, will be presented and compared to theoretical models. The rapidity ranges considered will include forward and backward rapidity (dimuon decay channel) and mid rapidity (dielectron decay channel). Likewise, a discussion on the forward-to-backward ratios will be held. First results on the dependence of the J/ψ yields and its mean transverse momentum on the charged particle multiplicity will be also presented and discussed.

Primary author(s) : MARTIN BLANCO, Javier (Laboratoire de Physique Subatomique et des Technologies Associe)

Presenter(s) : MARTIN BLANCO, Javier (Laboratoire de Physique Subatomique et des Technologies Associe)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **137** Type : **Contributed Talk**

Inclusive ψ(2S) production at forward rapidity in p-Pb and Pb-Pb collisions with ALICE at the LHC

Tuesday, 20 May 2014 15:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Charmonium states play a relevant role as probes of the phase transition between hadronic and deconfined matter. According to the color-screening model, the in-medium dissociation probability of such states should provide an estimate of the initial temperature. In nucleus-nucleus collisions, the more loosely bound excited states, as the ψ(2S), are expected to melt at lower temperatures than the ground state (J/ψ). In proton-nucleus collisions at LHC energies, the charmonium formation time is larger than the time spent by the ccbar pair traversing the nucleus. Therefore, the cold nuclear matter is expected to affect in a rather similar way the J/ψ and ψ(2S).

ALICE results on the inclusive ψ(2S) production at forward rapidities ($2.5 < y < 4$), will be presented. Final results on the ψ(2S)/J/ψ ratio in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV will be shown and compared to the corresponding pp measurement. Results on the ψ(2S) production in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV will be also discussed. We observe an unexpected suppression of the ψ(2S) yield, with respect to the J/ψ one, which is difficult to reconcile with the presence of cold nuclear matter effects alone. To provide further insight on this observation, a differential study of the ψ(2S) suppression, as a function of transverse momentum and centrality will be presented. Finally, ALICE ψ(2S) results will be compared with theoretical models and with results by other experiments.

Primary author(s) : ARNALDI, Roberta (Universita e INFN (IT))

Presenter(s) : ARNALDI, Roberta (Universita e INFN (IT))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **152** Type : **Contributed Talk**

Direct-photon spectra and flow in Pb-Pb collisions at the LHC measured with the ALICE experiment

Monday, 19 May 2014 15:00 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Unlike hadrons, direct photons are produced in all stages of a nucleus-nucleus collision and therefore test our understanding of the space-time evolution of the produced medium. Of particular interest are so-called thermal photons expected to be produced in a quark-gluon plasma and the subsequent hadron gas. The transverse momentum spectrum of thermal photons carries information about the temperature of the
emitting medium. The effect of Doppler blueshift on photons spectra from later and colder stages of a collision, however, potentially complicates the extraction of the temperature. In this presentation, direct-photon spectra in the range $1 < p_T < 12$ GeV/c from Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV will be shown. The results were obtained with two independent methods: by measuring photons with the electromagnetic calorimeter PHOS and by measuring e^+e^- pairs from external conversions of photons in the detector material. The measured direct-photon spectra will be compared with predictions from state-of-the-art hydrodynamic models. In addition, direct-photon production in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV will be discussed. In the standard hydrodynamical modeling of nucleus-nucleus collisions, thermal photons mostly come from the early hot stage of the
collision. As collective hydrodynamic flow needs time to build up, the azimuthal anisotropy of thermal photons quantified with Fourier coefficient v_2 is expected to be smaller than the one for
hadrons. However, the PHENIX experiment and ALICE experiment observed v_2 values of direct-photons similar in magnitude to the pion v_2. These unexpected observations constitute the so called
"direct-photon flow puzzle" as they challenge the standard hydrodynamic picture of nucleus-nucleus collisions and/or the standard photon emissions rates in the quark-gluon plasma and the hadron gas. We will present the inclusive photon v_2 and v_3 in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV in the range $1 < p_T < 5$ GeV/c and discuss implications for the v_2 and v_3 of direct-photons.

Primary author(s) : BOCK, Friederike (Ruprecht-Karls-Universitaet Heidelberg (DE))

Presenter(s) : BOCK, Friederike (Ruprecht-Karls-Universitaet Heidelberg (DE))

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **153** Type : **Contributed Talk**

Neutral meson production in pp, p-Pb and Pb-Pb collisions measured by ALICE at LHC

Tuesday, 20 May 2014 15:00 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The ALICE experiment at LHC performs measurements of neutral meson inclusive spectra in mid-rapidity in a wide p_{T} range in pp, p-Pb and Pb-Pb collisions, as well as correlations between leading π^0 and charged hadrons. Neutral mesons π^0, η, ω are reconstructed via complementary methods, using the ALICE electromagnetic calorimeters and by the central tracking system identifying photons converted to e^+e^- pairs in the material of the inner barrel detectors. Measurements of neutral meson spectra in pp collisions at energies $\sqrt{s}$ = 0.9, 2.76, 7 TeV provide valuable data for pQCD calculations and allow to study scaling properties of hadron production at the LHC energies. The study of neutral meson production in p-Pb collisions at $\sqrt{s} = 5.02$ TeV is of importance to confirm that the strong suppresion observed in central Pb-Pb collisions is a final-state effect of the produced dense medium. The nuclear modification factor R_{AA} of the π^0 production in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV at different collision centralities shows a clear pattern of strong suppression in a hot QCD medium with respect to pp collisions. We shall also present the current status of correlation measurements between π^0 or isolated photons triggered by the electromagnetic calorimeter EMCAL, and charged hadrons detected in the central tracker.

Primary author(s) : MARIN, Ana (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Presenter(s) : MARIN, Ana (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **165** Type : **Contributed Talk**

Freeze-out conditions from fluctuations of conserved charges: lattice meets experiment

Wednesday, 21 May 2014 11:30 (0:20)

On behalf of collaboration:

None

Abstract content

Recent results for moments of multiplicity distributions of net-protons and net-electric charge from the Star collaboration are compared to recent lattice QCD results for higher order fluctuations of baryon number and electric charge by the Wuppertal-Budapest collaboration. All lattice simulations are performed at the physical mass for light and strange quarks; all results are continuum extrapolated. We show that it is possible to extract an upper value for the freeze-out temperature, as well as precise baryo-chemical potential values corresponding to the four highest collision energies of the experimental beam energy scan. Consistency between baryon number and electric charge is also discussed.

Primary author(s) : RATTI, Claudia; BORSANYI, Szabolcs (University of Wuppertal); FODOR, Zoltan (BUW); KATZ, Sandor; KRIEG, Stefan (F); SZABO, Kalman (Wuppertal University)

Presenter(s) : RATTI, Claudia

Session Classification : QCD phase diagram

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **166** Type : **Contributed Talk**

Effects of magnetic fields on the quark-gluon plasma

Tuesday, 20 May 2014 09:40 (0:20)

On behalf of collaboration:

None

Abstract content

In this talk recent lattice QCD results are presented about the response of the thermal QCD vacuum to external (electro)magnetic fields. Characteristic features of this response include the reduction of the deconfinement transition temperature due to the magnetic field and the paramagnetic nature of the QCD vacuum as a medium. The latter results in a squeezing of the quark-gluon plasma if the field is not uniform. Possible implications of this squeezing for heavy-ion collisions are discussed.

Primary author(s) : ENDRODI, Gergely (U)

Presenter(s) : ENDRODI, Gergely (U)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **170** Type : **Contributed Talk**

Future upgrade and physics perspectives of the ALICE TPC

Wednesday, 21 May 2014 12:30 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The Time Projection Chamber (TPC) is one of the main tracking and PID devices in the central barrel of the ALICE detector at the CERN Large Hadron Collider. It provides precise charged-particle tracking, momentum measurement, and particle identification in very high multiplicity heavy-ion collisions. The readout rate of the TPC is currently limited by the necessity to prevent ions from the amplification region of the MWPC-based readout chambers to drift back into the drift volume, which is achieved through active ion gating by operating a dedicated Gating Grid. The relevant ion drift times limit the maximum trigger rate of the TPC to about 3.5 kHz.

In order to make full use of the increase in luminosity after the second long shutdown of the LHC, it is foreseen to operate the detector in an ungated mode with continuous readout. Therefore the existing MWPC readout will be replaced by a Gas Electron Multiplier (GEM) readout, which provides intrinsic ion capture capability without additional gating. Furthermore, new readout electronics will be implemented to match the requirements of continuous readout with GEMs. Together with advanced techniques for online space-charge corrections, the upgrade will enable the detector to perform to specifications at collision rates of up tp 50 kHz foreseen for the LHC Pb-Pb program in RUN 3. After the upgrade of the TPC, the data collection rate of the TPC in Pb-Pb will be increased by about a factor 100 as compared to the present system, which will enable improved measurements to understand heavy quark and quarkonium production, low-mass dielectron production, jets and jet correlations, and the production of exotic hadrons.

In this talk, the expected physics performance and status of the extensive R&D program to reach this ambitious goal will be presented.

Primary author(s) : GUNJI, Taku (University of Tokyo (JP))

Presenter(s) : GUNJI, Taku (University of Tokyo (JP))

Session Classification : Future experimental facilities, upgrades, and instrumentation

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **172** Type : **Contributed Talk**

The upgrade of the ALICE Inner Tracking System

Wednesday, 21 May 2014 12:10 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The long term plan of ALICE (A Large Ion Collider Experiment) is a detailed investigation and characterization of the Quark-Gluon Plasma (QGP) in order to fully exploit the scientific potential of the LHC with heavy ions at high luminosity after the Long Shutdown 2 (LS2) scheduled in 2018-2019. The study will focus on high precision measurements of rare probes over a wide range of momenta, which would require high statistics and are not satisfactory or even possible with the present experimental set up. To improve its physics capabilities, ALICE has formulated an upgrade strategy of several detectors to be installed during LS2 under the assumption that the LHC will progressively increase its luminosity with Pb beams eventually reaching an interaction rate of about 50 kHz. Within this upgrade strategy, the Inner Tracking System (ITS) upgrade forms an important cornerstone, providing precise measurements for heavy-flavour interactions with the QGP medium and for the production of thermal photons and low-mass dileptons by highly improved tracking and vertexing capabilities. These new measurements would provide an insight to the study of, in particular, the thermalization of heavy quarks in the QGP and the in-medium energy loss, and to assess the initial temperature and degrees of freedom of the system, respectively. The new ITS has a barrel geometry consisting of seven layers of Monolithic Active Pixel Sensors (MAPS) with high granularity, which would fulfil the material budget, readout and radiation hardness requirements for the upgrade. The layout and the properties of the new ITS are optimized for high tracking efficiency, both standalone and in combination with the outer Time Projection Chamber (TPC). In this contribution, the performance of the new ITS will be presented and compared to the current setup. An overview of the technical developments for the detector elements and of the construction procedures will also be presented.

Primary author(s) : SIDDHANTA, Sabyasachi (Universita e INFN (IT))

Presenter(s) : SIDDHANTA, Sabyasachi (Universita e INFN (IT))

Session Classification : Future experimental facilities, upgrades, and instrumentation

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **182** Type : **Contributed Talk**

Towards the heavy-ion program at J-PARC

Wednesday, 21 May 2014 12:50 (0:20)

On behalf of collaboration:

[Other]

Abstract content

J-PARC is going to achieve its designed proton beam power of 0.75 MW at 30 GeV for neutrino physics and 1 MW at 3 GeV for material and life sciences in several years. Recently, discussions of heavy ion acceleration as the future J-PARC project have been held among nuclear physicists and accelerator scientists. The main goals of the program are to explore the QCD phase diagram at high baryon density with the heaviest ions such as uranium at the beam energies of around 10 AGeV. We are planning to focus on the electron and muon measurements and rare probe search such as multi-strangeness and charmed hadrons by taking advantage of the world's highest beam power available at J-PARC, in addition to identified hadron measurements in large acceptance. A heavy-ion acceleration scheme has been considered with a new heavy-ion linac and a new booster ring, which accelerate and inject heavy-ion beams into the existing 3-GeV Rapid-Cycling Synchrotron, and the 30-GeV Main Ring synchrotron. We present the overview of the heavy-ion program and accelerator design, as well as physics goals and conceptual design of the heavy-ion experiments.

Primary author(s) : SAKO, Hiroyuki (Japan Atomic Research Agency)

Co-author(s) : SAKAGUCHI, Takao (BNL); SHIGAKI, Kenta (Hiroshima University (JP)); CHUJO, Tatsuya (University of Tsukuba (JP)); GUNJI, Taku (University of Tokyo (JP)); OZAWA, Kyoichiro (Graduate School of Science-University of Tokyo); Prof. IMAI, KenIchi (Japan Atomic Energy Agency); Dr. KANETA, Masashi (Tohoku University); Prof. NAGAMIYA, Shoji (RIKEN); Prof. KINSHO, Michikazu (Japan Atomic Energy Agency); Dr. HARADA, Hiroyuki (Japan Atomic Energy Agency); Dr. SAHA, Pranab (Japan Atomic Energy Agency); Dr. TAMURA, Jun (Japan Atomic Energy Agency); SATO, susumu (jaea)

Presenter(s) : SAKO, Hiroyuki (Japan Atomic Research Agency)

Session Classification : Future experimental facilities, upgrades, and instrumentation

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **203** Type : **Contributed Talk**

Viscous corrections to photon emission in heavy-ion collisions

Monday, 19 May 2014 12:20 (0:20)

On behalf of collaboration:

JET

Abstract content

Photons are believed to be clean and penetrating probes of the medium created in ultra-relativistic heavy-ion collisions. The thermal photon spectrum and its anisotropy coefficients, v_n, are known to be very sensitive to the thermalization time, the specific shear viscosity, the equation of state of produced matter, and the initial state fluctuations [1,2]. In this talk, we will present state-of-the-art calculations of event-by-event photon emission from nuclear collisions at RHIC and LHC energies including both shear and bulk viscous corrections. Momentum spectra of thermal photons and their p_T-differential anisotropic flow coefficients $v_n(p_T)$ (n up to 5) are computed, both with and without accounting for viscous corrections to the standard thermal emission rates. Viscous corrections to the rates are found to have a larger effect on the v_n coefficients than the viscous suppression of hydrodynamic flow anisotropies. Effects from non-zero initial flow and viscous pressure tensor to photon spectra and their anisotropies are also investigated by evolving fluctuating initial density profiles with free-streaming on the event-by-event basis before matching to hydrodynamics. Complementary to the majority of hadronic observables, thermal photons provide us with additional constraints on the evolution of the viscous pressure tensor as well as the early dynamics of heavy-ion collisions. Their anisotropic flows, especially higher order v_n, can be used as a sensitive viscometer for the quark-gluon plasma.
[1] C. Shen, U. Heinz, J.-F. Paquet and C. Gale, "Thermal photons as a quark-gluon plasma thermometer revisited", arXiv:1308.2440 [nucl-th].
[2] C. Shen, U. Heinz, J.-F. Paquet, I. Kozlov and C. Gale, "Anisotropic flow of thermal photons as a quark-gluon plasma viscometer", arXiv:1308.2111 [nucl-th].

Primary author(s) : SHEN, Chun (Ohio State University)

Co-author(s) : DENICOL, Gabriel (McGill University); GALE, Charles (McGill University); HEINZ, Ulrich (The Ohio State University); Mr. LIU, Jia (The Ohio State University)

Presenter(s) : SHEN, Chun (Ohio State University)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **204** Type : **Contributed Talk**

Production of light flavor hadrons at intermediate and high p_{T} measured with the ALICE detector

Monday, 19 May 2014 16:30 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Light flavor transverse momentum spectra at intermediate and high p_{T} are important as baseline perturbative QCD measurements in pp, evaluating initial state effects (nuclear p.d.f.'s) in p-Pb, and for investigating the suppression in Pb-Pb collisions. In this talk results for all these collisional systems will be presented.

The new measurement of R_{pPb} for unidentified charged particles extended up to 50 GeV/c will be presented together with the construction of the reference pp spectrum at $\sqrt{s} = 5.02$ TeV. The final results on the production of charged pions, kaons, and protons up to $p_{\mathrm{T}} = 20$ GeV/c in pp and Pb-Pb collisions will also be reported and compared to recent QCD and phenomenological calculations. The impact of these results on our interpretation of jet quenching in Pb-Pb through R_{AA} and the question of whether the proton-to-pion ratio can still be considered to be anomalous will be discussed.

Primary author(s) : KNICHEL, Michael Linus (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Presenter(s) : KNICHEL, Michael Linus (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **205** Type : **Contributed Talk**

Light (Hyper-)Nuclei production at the LHC measured with ALICE

Wednesday, 21 May 2014 09:40 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The high collision energies reached at the LHC lead to significant production yields of light (hyper-)nuclei in proton-proton, proton-lead and, in particular, lead-lead collisions. The excellent particle identification capabilities of the ALICE apparatus, based on the specific energy loss in the time projection chamber and the velocity information in the time-of-flight detector, allow for the detection of these rarely produced particles. Furthermore, the inner tracking system gives the possibility to separate primary nuclei from those coming from the decay of heavier systems. One example is the hypertriton ($^{3}_{\Lambda}$H $\rightarrow ^{3}$He + π^{-}) another one is the possible decay of a hypothetical bound state of a Λ with a neutron decaying into deuteron and pion. We present results on the production of stable nuclei and anti-nuclei in Pb–Pb and lighter collision systems. Hypernuclei production rates in Pb-Pb will also be shown, together with a measurement of the hypertriton lifetime and upper limits estimated on the production of lighter exotica candidates. All results are compared with predictions for the production in thermal (statistical) models and alternatives using coalescence.

Primary author(s) : MARTIN, Nicole Alice (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Presenter(s) : MARTIN, Nicole Alice (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Session Classification : Thermodynamics and hadron chemistry

Track Classification : Thermodynamics and Hadron Chemistry

Contribution ID : **206** Type : **Contributed Talk**

Measurement of inclusive jet suppression in Pb+Pb

Tuesday, 20 May 2014 10:00 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Highly energetic jets produced in relativistic heavy ion collisions provide an important tool to study the QCD medium created in these collisions. These jets suffer energy loss and modification of their parton shower through interactions with the medium— a phenomenon known as jet quenching. A generic feature of such energy loss is the reduction in jet production rates. In this talk, new ATLAS results will be presented on the suppression of inclusive jet production rates in Pb+Pb collisions at 2.76 TeV. Measurements of the nuclear modification factor RAA for fully reconstructed jets will be presented. These measurements cover a large kinematic range in jet transverse momentum and are differential in jet rapidity and collision centrality and provide sensitivity to the details of the quenching mechanism including the values of medium transport coefficients.

Primary author(s) : ANGERAMI, Aaron (Columbia University (US))

Presenter(s) : ANGERAMI, Aaron (Columbia University (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **207** Type : **Contributed Talk**

Multi-strange baryon production in pp, p-Pb and Pb-Pb collisions measured with ALICE at the LHC

Wednesday, 21 May 2014 09:00 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Multi-strange baryons are of particular interest in the understanding of particle production mechanisms, as their high strangeness content makes them more susceptible to changes in the hadrochemistry of the colliding systems. In this talk, Ξ and Ω production rates measured with ALICE are reported as a function of p_{T} in proton-proton (pp), proton-lead (p-Pb) and lead-lead (Pb-Pb) collisions. Multi-strange baryons were reconstructed via the detection of their weak decay products, which were identified through their measured energy loss and momenta in the ALICE Time Projection Chamber. For p-Pb and Pb-Pb, the Ξ and Ω spectra were analysed as a function of charged particle multiplicities, which range over several orders of magnitude. In the p-Pb system in particular, it is possible to investigate a multiplicity region in which relative strangeness production changes significantly, as seen when comparing peripheral Pb-Pb to pp collisions. In order to investigate the phenomenon of strangeness enhancement, we study how the singly-strange and multi-strange baryon production relative to non-strange particles evolves with multiplicity. Finally, the results from these various colliding systems are also compared to each other as well as to Monte Carlo predictions.

Primary author(s) : ALEXANDRE, Didier (University of Birmingham (GB))

Presenter(s) : ALEXANDRE, Didier (University of Birmingham (GB))

Session Classification : Thermodynamics and hadron chemistry

Track Classification : Thermodynamics and Hadron Chemistry

Contribution ID : **211** Type : **Contributed Talk**

Angular correlations of jets in lead-lead collisions at 2.76 TeV using the ATLAS detector at LHC

Wednesday, 21 May 2014 09:20 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Highly energetic jets produced in nuclear collisions are considered to be a direct probe of hot and dense medium created in the collision. The jet measurements both at LHC and RHIC indicate a presence of "jet quenching" - strong energy loss of fast partons in the hot and dense QCD medium. This talk presents study of properties of the multi-jet production in heavy ion collisions presented in terms of jet angular correlations. The jet angular correlations are valuable tool to study the beyond leading order effects in QCD and are expected to shade a new light on the process of the energy loss. The analysis is performed using Pb+Pb data collected in 2011 by the ATLAS detector at the center of mass energy of 2.76 TeV.

Primary author(s) : RYBAR, Martin (Charles University (CZ))

Presenter(s) : RYBAR, Martin (Charles University (CZ))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **216** Type : **Contributed Talk**

Hadronic resonance production measured by ALICE at the LHC

Tuesday, 20 May 2014 11:30 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Hadronic resonances constitute a valuable probe for the properties of the medium formed in heavy-ion collisions. In particular, they provide information on particle-formation mechanisms, the properties of the medium at freeze-out, and they contribute to the systematic study of energy loss and recombination. The study of resonance production in other collision systems such as pp and p-Pb form a necessary baseline to disentangle initial-state effects from genuine medium-induced effects. The ALICE experiment has measured the production of the $K(892)^0$ and $\phi(1020)$ resonances at mid-rapidity in different collision systems at LHC energies. Resonances are reconstructed via their hadronic decay in a wide momentum range, by exploiting the excellent particle-identification capabilities of the Time-Projection Chamber and the Time-of-Flight system. The first results on $K(892)^0$ and $\phi(1020)$ production in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV at the LHC will be presented. The resonance mass and width, transverse momentum spectra and yields are measured and reported as a function of the multiplicity of the p-Pb collision. Ratios of resonance to long-lived hadron production in Pb-Pb are compared with the same quantities measured in pp and p-Pb collisions, in order to investigate re-scattering effects. The nuclear modification factors ($R_{\rm AA}$, $R_{\rm pPb}$), recently measured up to high $p_{\rm T}$ for resonances, are compared to the same measurement for long lived hadrons. The results are discussed in comparison with measurements at lower energies and theoretical predictions.

Primary author(s) : BELLINI, Francesca (Universita e INFN (IT))

Presenter(s) : BELLINI, Francesca (Universita e INFN (IT))

Session Classification : QCD at high temperature and/or density

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **217** Type : **Contributed Talk**

Jet fragmentation in lead-lead collisions at 2.76 TeV using the ATLAS detector at LHC

Tuesday, 20 May 2014 14:40 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Measurements of charged particle fragmentation functions of jets produced in ultra-relativistic nuclear collisions are expected to provide insight on the modification of parton showers in the hot and dense medium created in the collisions. ATLAS has measured jets at sqrt{sNN}=2.76 TeV in Pb+Pb collisions using data collected during 2011 run and in p+p collisions using 2013 run. Jets were reconstructed using the anti-kt algorithm with distance parameter values R=0.2, 0.3, and 0.4. Distributions of charged particle transverse momentum and longitudinal momentum fraction are reported for seven bins in collision centrality. The ratios of fragmentation distributions with respect to the p+p reference fragmentation functions are evaluated. The jet structure is further investigated in terms of correlations of an angular position and momenta of a particle within jet.

Primary author(s) : SPOUSTA, Martin (Columbia University and Charles University)

Presenter(s) : SPOUSTA, Martin (Columbia University and Charles University)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **218** Type : **Contributed Talk**

Measurements of charged particle spectra and nuclear modification factors in proton-lead and lead-lead collisions with the ATLAS detector

Tuesday, 20 May 2014 11:30 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

The measurement of charged particle spectra in heavy ion collisions carries important information about the properties of hot and dense matter created in these interactions. Spectra measured in lead-lead collisions at different centralities can be compared to the proton-proton spectra giving quantitative information about the properties of such matter. Proton-nucleus collisions provide further means for understanding the role of the initial state effects modifying the hard scattering rates.
The ATLAS detector at the LHC obtained the sample of Pb+Pb data at $\sqrt{s_{\rm NN}} = 2.76$ TeV with integrated luminosity 0.15 nb^{-1}, which can be compared to recently obtained pp sample of 4.5 pb^{-1} sample at the same energy. The p+Pb data at $\sqrt{s_{\rm NN}} = 5.02$ TeV with integrated luminosity 30 nb^{-1} can also be compared to the pp data obtained by interpolating pp measurements at $\sqrt{s} = 2.76$ TeV and 7 TeV. Due to the excellent capabilities of the ATLAS detector, and its stable operation in heavy ion as well as proton-proton physics runs, the data allow measurements of the nuclear modification factor out to transverse momentum limited only by the statistics of the accumulated samples and studying the ratios of HI charged particle spectra divided by pp reference in different centrality bins over a wide range of pseudorapidity.

Primary author(s) : BALEK, Petr (Charles University (CZ))

Presenter(s) : BALEK, Petr (Charles University (CZ))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **219** Type : **Contributed Talk**

Centrality and rapidity dependence of inclusive jet production in p+Pb collisions at 5.02 TeV with the ATLAS detector

Tuesday, 20 May 2014 12:30 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Measurements of reconstructed jets in high-energy proton-nucleus collisions over a wide rapidity and transverse momentum range are a fundamental probe of the partonic structure of nuclei. Inclusive jet production is sensitive to the modification of parton distribution functions in the high-density nuclear environment. In the forward direction and at small pT jets may even explore the transition from a dilute to saturated partonic system. Furthermore, any modification of jet production in p+A collisions has implications for our understanding of the strong suppression seen in central A+A collisions. We present the latest results on inclusive jet production in 31/nb of proton-lead collisions at 5.02 TeV with the ATLAS detector at the LHC. The centrality of p+Pb events is determined by applying the Glauber model to the sum of the transverse energy in the Pb-going forward calorimeter. The jet yields in central and peripheral p+Pb collisions are found to be suppressed and enhanced, respectively, relative to geometric expectations. Furthermore, the modifications at all rapidities are seen to be consistent with a simple function of the total jet energy.

Primary author(s) : PEREPELITSA, Dennis Vadimovich (Brookhaven National Laboratory (US))

Presenter(s) : PEREPELITSA, Dennis Vadimovich (Brookhaven National Laboratory (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **220** Type : **Contributed Talk**

Studies of cold nuclear matter effects in production of low mass quarkonia in p+Pb collisions with the ATLAS detector

Tuesday, 20 May 2014 14:40 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Measurements of quarkonia in p-A collisions allow the study of cold nuclear matter (CNM) effects on its production. These studies offer insight into fundamental features of QCD, such as properties of gluon densities at low x, as well as being a means of disentangling and calibrating the influence of non-QGP related effects in A-A collisions. Extraction of quarkonium production characteristics from proton-lead collisions at sqrt(sNN) = 5.02 TeV collected with the ATLAS detector will be shown. The analysis separates J/psi coming from b-hadron decays from directly produced J/psi mesons, using the displaced vertex of the mesonic decay. This allows the dedicated study of CNM effects in b-quark production, its comparison with prompt J/psi sheds light in the role of quark mass in these effects. The production is studied as a function of rapidity, in the range -2.9 < y* 1.9 and high and transverse momentum from 6 to 30 GeV.

Primary author(s) : ARRATIA MUNOZ, Miguel Ignacio (University of Cambridge (GB))

Presenter(s) : ARRATIA MUNOZ, Miguel Ignacio (University of Cambridge (GB))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **225** Type : **Contributed Talk**

Measurement of the centrality dependence of the charged particle pseudorapidity distribution in proton-lead collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with the ATLAS detector

Monday, 19 May 2014 11:00 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Proton-lead collisions at the LHC provide an opportunity to probe the physics of the initial state of ultra-relativistic heavy ion collisions. In particular, they can provide insight on the effect of an extended nuclear target on the dynamics of soft and hard scattering processes and subsequent particle production. Charged particle multiplicity and pseudorapidity distributions are among the most basic experimental probes of particle production.

The centrality dependence of the charged particle pseudorapidity distributions, dNch/deta , was measured in p+Pb collisions at a nucleon-nucleon centre-of-mass energy of sqrt(s_NN) = 5.02 TeV using the ATLAS detector. Charged particles were reconstructed over |eta| < 2.7 using the ATLAS pixel detector. The proton-lead collision centrality was characterized by the total transverse energy measured over the pseudorapidity interval 3.2 < eta < 4.9 in the direction of the lead beam. The dNch/deta distributions are found to vary strongly with centrality, with an increasing asymmetry between the proton-going and Pb-going directions as the collisions become more central. Three different calculations of the number of participants, Npart, have been carried out using a standard Glauber model as well as two Glauber-Gribov extensions. Charged particle multiplicities per participant pair are found to vary differently with Npart for these three models, highlighting the importance of the fluctuating nature of nucleon-nucleon collisions in the modeling of the initial state of p+Pb collisions.

Primary author(s) : DEBBE VELASCO, Ramiro Rolando (Brookhaven National Laboratory (US))

Presenter(s) : DEBBE VELASCO, Ramiro Rolando (Brookhaven National Laboratory (US))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **227** Type : **Contributed Talk**

Elucidating the event-shape fluctuations via flow correlations and jet tomography studies in 2.76 TeV Pb+Pb collisions using the ATLAS detector

Tuesday, 20 May 2014 09:40 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Measurements of the distributions of event-by-event flow harmonics v_n and the correlations between harmonics v_n and v_m of different orders in $\sqrt{s_{NN}} = 2.76$ TeV Pb+Pb collisions are presented. These measurements give insight into the nature of fluctuations in the initial geometry and the role of linear and non-linear hydrodynamic response to the fluctuations, the latter can introduce correlations between flow harmonics. The study of fluctuations is also extended by measurements of the rapidity dependent fluctuations in the v_n. Furthermore, the event-by-event fluctuations in the event shape is elucidated by jet-tomography studies, where the correlations between the v_n of fully reconstructed jets and the v_m of soft particles are measured. The latter directly probes the path-length dependent jet quenching response to the variation of the event-shape controlled by bulk particles.

Primary author(s) : MOHAPATRA, Soumya (State University of New York (US))

Presenter(s) : MOHAPATRA, Soumya (State University of New York (US))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **230** Type : **Contributed Talk**

Flow harmonics in Pb+Pb collisions at energy of sqrt(sNN) = 2,76 TeV with the ATLAS detector

Tuesday, 20 May 2014 12:30 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

We report on measurements of the anisotropy of charged particles in lead-lead collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV, using multi-particle cumulants calculated with the generating function method. The results on the transverse momentum, pseudorapidity and centrality dependence of the elliptic flow (v2) obtained from two-, four-, six- and eight-particle cumulants are presented. Higher-order coefficients, v3 and v4 are also derived using two- and four-particle cumulants and shown as a function of centrality and transverse momentum. A reduction of contributions not related to the initial geometry for vn studied with cumulant expansion of correlations between more than two particles is discussed. Event-by-event fluctuations of the flow harmonics evaluated with multi-particle cumulants as a function of transverse momentum and the collision centrality are also presented. These results are complemented with the pT-integrated elliptic flow measured in the pseudorapidity range $|\eta|< 2.5$ with the event plane method, exploring the range of very low transverse momenta. This was achieved by applying dedicated track reconstruction methods. The centrality dependence of the integrated v2, spanning the range of 0–80% of most central Pb+Pb collisions, is compared to other measurements obtained with higher p_T thresholds. The pseudorapidity dependence of the integrated elliptic flow in different centrality intervals is discussed and compared to the lower energy RHIC data.

Primary author(s) : DERENDARZ, Dominik Karol (Polish Academy of Sciences (PL))

Presenter(s) : DERENDARZ, Dominik Karol (Polish Academy of Sciences (PL))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **232** Type : **Contributed Talk**

Light flavor hadron spectra at low-p_{T} and search for collective phenomena in high multiplicity pp, p-Pb and Pb-Pb collisions measured with the ALICE experiment

Monday, 19 May 2014 12:00 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Comprehensive results on transverse momentum distributions, their ratios, $\mathrm{d}N/\mathrm{d}y$ and $<p_{\mathrm{T}}>$ values for identified light flavor hadrons (π, K, p, Λ, Ξ, Ω) at low p_{T} and mid rapidity are reported for all collision systems at LHC energies: pp, p-Pb, Pb-Pb. It is well known that strong collective effects are observed in central Pb-Pb collisions as a particle mass dependent hardening of the spectral shapes attributed to hydrodynamical flow and may be quantitatively parametrized with Boltzmann-Gibbs Blast Wave fits. In this talk, we investigate the existence of collective phenomena in small systems: pp, p-Pb and peripheral Pb-Pb where similar patterns are observed in multiplicity dependent studies. For pp collisions, measurements at three center-of-mass energies ($\sqrt{s}$ = 0.9, 2.76, 7 TeV) are presented and the evolution of the spectral shape with $\sqrt{s}$ is discussed.

Primary author(s) : ANDREI, Cristian (IFIN-HH Bucharest (RO))

Presenter(s) : ANDREI, Cristian (IFIN-HH Bucharest (RO))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **233** Type : **Contributed Talk**

Studies of the correlation between hard jet production and the soft underlying event in proton-proton collisions at 2.76 TeV with the ATLAS detector at the LHC

Tuesday, 20 May 2014 12:50 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Measurements of the rate of hard processes can serve as invaluable probes of possible initial state effects in ultrarelativistic proton-nucleus collisions. Importantly, these measurements are performed with different selections on the collision geometry, which is typically achieved through associating geometric quantities derived in the Glauber model with the measured soft underlying event activity away from the hard probe. However, the underlying event in proton-nucleus collisions with a high-Q^2 partonic scattering may be modified by the associated hard process and no longer reflect only the geometry of the collision, which could result in an incorrect assignment of the centrality for events with hard processes. These hard-soft correlations are best studied in proton-proton collections, in which the geometry is known. We present a study of the soft underlying event activity in the presence of high-pT jets in proton-proton collisions at 2.76 TeV with the ATLAS detector at the LHC. The soft underlying event activity of interest is the sum of the transverse energy in the forward calorimeters ($3.1 < |\mathrm{eta}| < 4.9$), which is the same observable used for the centrality determination in proton-lead collisions by ATLAS. Furthermore, the hard-soft correlations are studied as a function of the rapidity and transverse momentum of the produced jets and, through the selection of exclusive dijet event topologies, as a function of the underlying kinematics of the parton-parton hard scattering.

Primary author(s) : STEINBERG, Peter Alan (Brookhaven National Laboratory (US))

Presenter(s) : STEINBERG, Peter Alan (Brookhaven National Laboratory (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **238** Type : **Contributed Talk**

Freeze-out radii extracted using two- and three-pion Bose-Einstein correlations in pp, p-Pb, and Pb-Pb collisions at the LHC

Wednesday, 21 May 2014 11:30 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Two-pion Bose-Einstein correlations are often used to extract the radius of the particle emitting source at freeze-out. The extraction of the radii in low multiplicity systems is complicated by the presence of background correlations such as mini-jets. Such backgrounds can be suppressed through the use of three-pion cumulant correlations. We present two- and three-pion Bose-Einstein correlations in pp, p-Pb, and Pb-Pb collisions with ALICE at the LHC. The extracted freeze-out radii are compared in all three systems at similar multiplicity. The results are discussed in view of initial and final state effects.

Primary author(s) : GANGADHARAN, Dhevan Raja (Lawrence Berkeley National Lab. (US))

Presenter(s) : GANGADHARAN, Dhevan Raja (Lawrence Berkeley National Lab. (US))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **239** Type : **Contributed Talk**

Azimuthally differential pion femtoscopy in Pb-Pb collisions at $\sqrt{s_{\rm NN}}$ = 2.76 TeV with ALICE at the LHC

Wednesday, 21 May 2014 13:10 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Femtoscopy of non-central heavy-ion collisions provides access to information on the geometry of the effective pion-emitting source. In particular, its shape can be studied by measuring femtoscopic radii as a function of the emission angle relative to the collision plane of symmetry.

We present the first measurements of azimuthally differential femtoscopy in Pb-Pb collisions $\sqrt{s_{\rm NN}}$ = 2.76 TeV at the LHC and compare our results to RHIC experiments at lower energies. We measure oscillations of the extracted radii versus the emission angle. We find that $R_{\rm side}$ and $R_{\rm out}$ oscillate out of phase. We show that the relative amplitude of the $R_{\rm side}$ oscillation decreases in more central collisions, but always remains positive. This indicates that the source is out-of-plane extended, which is qualitatively similar to that observations at RHIC energies. We compare our results to existing hydrodynamical and transport model calculations.

Primary author(s) : LOGGINS, Vera (Wayne State University (US))

Presenter(s) : LOGGINS, Vera (Wayne State University (US))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **241** Type : **Contributed Talk**

Charge-dependent anisotropic flow and the search for the Chiral Magnetic Wave in ALICE

Tuesday, 20 May 2014 11:10 (0:20)

On behalf of collaboration:

ALICE

Abstract content

While no P- or CP-violation has ever been observed in the strong sector of the Standard Model, there is no first principles reason for it not to be present. Theoretical calculations have shown the possibility of P-violating bubbles in the QCD vacuum, which in combination with the strong magnetic field created in off-central heavy-ion collisions leads to the Chiral Magnetic Effect (CME). In addition, a coupling between the CME and the related Chiral Separation Effect produces a wave-like excitation called the Chiral Magnetic Wave (CMW). The CMW produces a quadrupole moment that always has the same sign and is therefore present in an average over events. In this talk we present a series of charge-dependent anisotropic flow measurements in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV in ALICE. The relation of these measurements to the search for the CMW is discussed.

Primary author(s) : BELMONT, Ron (Wayne State University (US))

Presenter(s) : BELMONT, Ron (Wayne State University (US))

Session Classification : Correlations and fluctuations

Track Classification : Collective Dynamics

Contribution ID : **242** Type : **Contributed Talk**

Searches for azimuthal flow in pp, p-Pb and Pb-Pb collisions from ALICE

Monday, 19 May 2014 16:30 (0:20)

On behalf of collaboration:

ALICE

Abstract content

A key question facing the heavy-ion physics community is whether or not collective behavior develops in elementary collisions. We will utilize a variety of techniques designed to obtain elliptic and triangular flow coefficients (v_2 and v_3) on data from pp $\sqrt{s} = 7$ TeV and p-Pb $\sqrt{s_{\rm NN}} = 5.02$ TeV collisions. We will report new measurements of second, fourth, and sixth particle flow cumulants for charged hadrons in p-Pb collisions as a function of charged hadron multiplicity, and discuss their response to few and global azimuthal correlations. New results will also be shown for Pb-Pb $\sqrt{s_{\rm NN}} = 2.76$ TeV, as they provide a crucial reference for such studies. Finally, we will report new measurements of $v_2\{SP\}$ for charged hadrons and identified particles for pp and p-Pb collisions. Investigations into mass ordering and comparisons to measurements of $v_2\{SP\}$ from Pb-Pb collisions will be carried out.

Primary author(s) : TIMMINS, Anthony Robert (University of Houston (US))

Presenter(s) : TIMMINS, Anthony Robert (University of Houston (US))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **243** Type : **Contributed Talk**

Searches for p_{T} dependent flow angle and flow magnitude fluctuations with the ALICE detector

Tuesday, 20 May 2014 09:00 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Anisotropic azimuthal correlations are used to probe the properties and the evolution of the system created in heavy-ion collisions. Hydrodynamic model calculations predict that there are effects of p_{T} dependent fluctuations of the flow angle and flow magnitude, which might bias our previous anisotropic flow measurements.
In this talk, the two effects will be investigated in both Pb-Pb and p-Pb collisions, using two-particle azimuthal correlation measurements with the ALICE detector. In addition, the factorization of the two-particle Fourier harmonics $V_{n\Delta}$ for different values of n into single-particle azimuthal anisotropies v_n, will be discussed. Our measurements, together with the comparison to hydrodynamic model calculations will open a new window on the study of the initial state fluctuations and the extraction of shear viscosity of the quark-gluon plasma at the LHC.

Primary author(s) : ZHOU, You (NIKHEF and University of Utrecht (NL))

Presenter(s) : ZHOU, You (NIKHEF and University of Utrecht (NL))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **244** Type : **Contributed Talk**

Elliptic flow of identifed particles in Pb-Pb collisions at the LHC

Monday, 19 May 2014 14:40 (0:20)

On behalf of collaboration:

ALICE

Abstract content

We report the measurements of elliptic flow for identified particles produced in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV with the ALICE detector at the LHC. The second Fourier coefficient, v_2, measured with the scalar product method with a large pseudo-rapidity gap of $|\Delta\eta| > 2.0$, is reported for π, $\rm K^{\pm}$, $\rm K^0_s$, p ($\overline{\rm p}$), ϕ, Λ ($\overline{\Lambda}$), Ξ and Ω.
We will present the transverse momentum $p_{\rm T}$ dependence of the v_2 of each particle for several centrality classes. In the low $p_{\rm T}$ region ($p_{\rm T} < 2$ GeV/c) our data are described fairly well by hydrodynamical calculations. We will discuss our results in the intermediate $p_{\rm T}$ region $2 < p_{\rm T} < 5$ GeV/c, where the scaling with the number of constituent quarks was first reported at RHIC energies.

Primary author(s) : PEREZ LARA, Carlos Eugenio (NIKHEF (NL))

Presenter(s) : PEREZ LARA, Carlos Eugenio (NIKHEF (NL))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **245** Type : **Contributed Talk**

Long-range angular correlations at the LHC with ALICE

Tuesday, 20 May 2014 14:40 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The observation of long-range correlations on the near- and away-side (also known as the double-ridge) in high-multiplicity p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV and its similarity to Pb-Pb collisions remains one of the open questions from the p-Pb run at the Large Hadron Collider. It has been attributed to mechanisms that involve initial-state effects, such as gluon saturation and colour connections forming along the longitudinal direction, and final-state effects, such as parton-induced interactions and collective effects developing in a high-density system possibly formed in these collisions. In order to understand the nature of this double-ridge structure the two-particle correlation analysis has been extended to identified particles. The observed mass dependence in p-Pb resembles qualitative expectations from hydrodynamics, and is also observed in Pb-Pb collisions. A study of correlations at forward rapidity probes the low-x regime of the nucleus, where saturation effects are expected to become stronger. The possibility of accessing this regime using the ALICE forward muon detector is explored. In addition, a possible ridge signal within the ALICE acceptance in pp collisions $\sqrt{s} = 7$ TeV is also investigated.

Primary author(s) : MILANO, Leonardo (CERN)

Presenter(s) : MILANO, Leonardo (CERN)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **253** Type : **Contributed Talk**

Heavy-flavour production as a function of multiplicity in pp and p-Pb collisions

Monday, 19 May 2014 15:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

The measurement of heavy-flavour production cross sections in pp collisions at the LHC provides a reference for heavy-ion studies and represents a test for perturbative QCD calculations. In p-Pb collisions, heavy-flavour measurements are essential to assess the effects due to the presence of a nucleus in the initial state, such as the modification of the parton densities and the k_{T}-broadening resulting from multiple soft scatterings of the partons. Heavy-flavour measurements as a function of the multiplicity of charged particles produced in the collision are sensitive to the interplay between hard and soft contributions to particle production and, in particular, could give insight into the role of multi-parton interactions (MPI), i.e. several hard partonic interactions occuring in a single collision at high centre-of-mass energies.

In this talk we will focus on the measurement of open heavy-flavour production as a function of charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 7 TeV and p-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$=5.02 TeV recorded with the ALICE detector in 2010 and 2013, respectively. D^0, D^+ and D^{*+} are reconstructed from their hadronic decay modes in the central rapidity region, and their yields are measured in different multiplicity and p_{T} intervals.

The per-event yield of D mesons in the different multiplicity intervals, normalized to its multiplicity-integrated value, and its evolution with p_{T} will be compared for pp and p-Pb collisions to study the contribution of MPI to open charm production in the two systems. The nuclear modification factor of D mesons in p-Pb collisions, defined as the ratio of the D-meson yield in p-Pb and pp collisions scaled by the number of binary collisions N_{coll}, will be discussed in terms of its multiplicity dependence. Results obtained with different multiplicity estimators will be shown in order to better understand the connection between multiplicity and collision geometry, which is needed to determine N_{coll}.

Primary author(s) : RUSSO, Riccardo (Universita e INFN (IT))

Presenter(s) : RUSSO, Riccardo (Universita e INFN (IT))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **283** Type : **Contributed Talk**

Multi-Particle production and ridge structure in A+A, p+A, and p+p collisions

Wednesday, 21 May 2014 09:00 (0:20)

On behalf of collaboration:

None

Abstract content

The IP-Glasma initial state model [1,2] coupled to relativistic viscous fluid dynamics successfully describes particle spectra, anisotropic flow, and its fluctuations in central to mid-central heavy-ion collisions [3]. Here we extend the study to more peripheral events and determine if the description remains robust. We then perform a direct comparison of peripheral A+A events with p+A and p+p events in the same multiplicity bins. Ridge-like correlations from the initial glasma state can also be computed in the IP-Glasma framework. We analyze their contribution which can be strong in small systems but is reduced in heavy-ion collisions.
[1] B. Schenke, P. Tribedy, R. Venugopalan, Phys. Rev. Lett. 108, 252301 (2012)
[2] B. Schenke, P. Tribedy, R. Venugopalan, Phys. Rev. C89, 024901 (2014)
[3] C. Gale, S. Jeon, B. Schenke, P. Tribedy, R. Venugopalan, Phys. Rev. Lett. 110, 012302 (2013).

Primary author(s) : Dr. SCHENKE, Bjoern (Brookhaven National Lab)

Co-author(s) : VENUGOPALAN, Raju (Brookhaven National Laboratory)

Presenter(s) : Dr. SCHENKE, Bjoern (Brookhaven National Lab)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **288** Type : **Contributed Talk**

Multiplicity fluctuation from hydrodynamic noise

Wednesday, 21 May 2014 13:10 (0:20)

On behalf of collaboration:

None

Abstract content

We discuss multiplicity fluctuation caused by noises during hydrodynamic evolution of the quark-gluon fluid created in high-energy nuclear collisions. In this talk, we claim the following non-trivial consequences within a framework of relativistic fluctuating hydrodynamics [1]:

- Multiplicity (being approximately proportional to entropy) fluctuates from event to event due to hydrodynamic fluctuation of dissipative currents such as shear stress tensor and bulk pressure even if the initial state is the same in a macroscopic sense.
- *Event-averaged* entropy has to increase with time so that the system obeys the second law of thermodynamics as it should be. Entropy in a certain event can, however, *decrease* with time temporarily and locally due to the hydrodynamic fluctuations.
- The probability of decreasing entropy during hydrodynamic evolution is, of course, very small in general. Interestingly, the probability is quantified by the *fluctuation theorem* [2] as known in the non-equilibrium statistical mechanics.

We first discuss the fluctuation theorem in non-equilibrium statistical mechanics [2]. The fluctuation theorem has been a milestone in non-equilibrium statistical mechanics since the linear response theory was established. Since the fluctuation theorem contains the Green-Kubo formula at long-time limit, it is believed to capture some important properties of non-equilibrium processes away from equilibrium.
We next solve the stochastic equation for dissipative currents together with the temporal evolution equation for the energy density in one-dimensionally expanding coordinate [3] to demonstrate that the final entropy fluctuates from event to event for a given initial condition. During the time evolution of the total entropy in a certain event, reduction of the entropy occurs due to hydrodynamic fluctuation of dissipative currents. We show that the probability of decreasing entropy just obeys the above-mentioned fluctuation theorem.
We finally discuss the physics consequences of hydrodynamic fluctuations on final observables. Fluctuation of the final entropy is taken over by the one of multiplicity. Thus we discuss multiplicity distribution functions from a hydrodynamic fluctuation point of view. We also discuss observables in small system such as p+p or p/d+A collisions since the effect of fluctuations are of particular importance in such smaller systems.

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[3] J. D. Bjorken, Phys. Rev. D **27**, 140 (1983).

Primary author(s) : HIRANO, Tetsufumi (Sophia Univ)

Co-author(s) : MURASE, Koichi (The University of Tokyo); KURITA, Ryuichi (the University of Tokyo); NAGAI, Kenichi (Sophia University)

Presenter(s) : HIRANO, Tetsufumi (Sophia Univ)

Session Classification : QCD phase diagram

Track Classification : New Theoretical Developments

Contribution ID : **297** Type : **Contributed Talk**

Photon suppression and dilepton enhancement in semi-QGP

Monday, 19 May 2014 12:40 (0:20)

On behalf of collaboration:

None

Abstract content

Experimental measurements of photon collective flow have obtained v2 comparable to those of hadrons. This favors a scenario of hadron dominated medium in photon production. A realistic calculation of photon rate in QGP phase is important to scrutinize this scenario. Fire ball produced in RHIC and LHC is close to semi-QGP which has a non-trivial value of Polyakov loop. We calculated the photon rate in the semi-QGP and found indeed a suppression of the photon rate due to non-trivial Polyakov loop, as compared to standard thermal perturbative results. We also calculated dilepton rate in the same semi-QGP. On the contrary, we found non-trivial Polyakov loop enhances the dilepton rate. This implies the v2 of dilepton distinguishes from that of photon.

Primary author(s) : LIN, Shu (RIKEN BNL); SATOW, Daisuke (RIKEN BNL); PISARSKI, Rob (Brookhaven National Laboratory)

Presenter(s) : LIN, Shu (RIKEN BNL)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **305** Type : **Contributed Talk**

Measurements of vector boson production in lead-lead and proton-lead collisions with the ATLAS detector

Monday, 19 May 2014 17:30 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Photons and weak bosons do not interact strongly, and thus their production yields provide direct tests of binary collision scaling, and in addition should be sensitive to the nuclear modification of parton distribution functions (nPDFs). Proton-lead collisions also provide an excellent opportunity to test nPDFs in a less dense environment than lead-lead, along with useful forward backward asymmetries in the final state. The ATLAS detector has proven to be an excellent apparatus in measurements involving photons, electrons and muons, the latter being products of weak-boson decays, in the high occupancy environment produced in heavy ion collisions. The experiment has recorded 30 nb^{-1} of proton-lead data and 140 μb^{-1} of lead-lead data, both of which have similar integrated partonic luminosities. We will present the prompt photon, Z and W boson yields as a function of centrality, and also differentially in transverse momentum and rapidity, in lead-lead and proton-lead collisions from the ATLAS experiment. For W bosons also a lepton charge asymmetry has been studied, which may also shed light on nPDFs.

Primary author(s) : GRABOWSKA-BOLD, Iwona (AGH University of Science and Technology (PL))

Presenter(s) : GRABOWSKA-BOLD, Iwona (AGH University of Science and Technology (PL))

Session Classification : Electromagnetic probes

Track Classification : Collective Dynamics

Contribution ID : **307** Type : **Contributed Talk**

New universal parametrization of initial-state fluctuations and its application to event-by-event anisotropy

Tuesday, 20 May 2014 12:50 (0:20)

On behalf of collaboration:

None

Abstract content

We propose a new, universal parametrization of the probability distribution of initial anisotropies in proton-proton, proton-nucleus and nucleus-nucleus collisions. The distribution of fluctuation-driven anisotropies, such as the initial triangularity ε_3, is described by a one-parameter power distribution. When a mean anisotropy in the reaction plane is also present, as in the case of the the initial eccentricity ε_2 in nucleus-nucleus collision, a new parameter must be added: the power distribution is replaced by a new, elliptic power distribution. Our results are in excellent agreement with all Monte-Carlo models of the initial state (Glauber, KLN, IP-Glasma) for all collision systems and all centralities.

We then apply our results to the interpretation of the event-by-event distributions of v_2 and v_3 recently measured by the ATLAS collaboration in Pb-Pb collisions at the LHC. Assuming that anisotropic flow is proportional to the initial anisotropy, $v_n = C_n\varepsilon_n$, we obtain excellent fits to these data. This procedure gives us direct information on the initial state from data. Our results are compared to several initial-state models. We are also able to extract the hydrodynamic response C_n for $n = 2, 3$ as a function of centrality, without assuming any particular model for the initial state. These results are compared with viscous hydrodynamic calculations of the response.

L. Yan and J. Y. Ollitrault, "Universal fluctuation-driven eccentricities in proton-nucleus and nucleus-nucleus collisions," arXiv:1312.6555 [nucl-th], to appear in Phys. Rev. Lett.

L. Yan, A. M. Poskanzer and J. Y. Ollitrault, in preparation.

Primary author(s) : YAN, Li; Dr. OLLITRAULT, Jean-Yves (CNRS); Dr. POSKANZER, Art (Lawrence Berkeley National Laboratory)

Presenter(s) : YAN, Li

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **310** Type : **Contributed Talk**

Structure of chromomagnetic fields in the glasma

Monday, 19 May 2014 15:20 (0:20)

On behalf of collaboration:

None

Abstract content

The initial stage of a heavy ion collision is dominated by nonperturbatively strong chromo-electric and -magnetic fields. The properties of these fields can be calculated numerically using the CGC description of the small x degrees of freedom of the colliding nuclei. The spatial Wilson loop provides a gauge invariant observable to probe the dynamics of the longitudinal chromomagnetic field. This talk describes the results from a recent real time lattice calculation (arXiv:1401.4124) of the area-dependence of the expectation value of the spatial Wilson loop.

We consider ensembles of gauge field configurations generated from the MV-model classical Gaussian effective action as well as solutions of the JIMWLK high-energy renormalization group equation with fixed and running coupling. The initial fields exhibit domain-like structure over distance scales of the order of the saturation scale. At later times universal scaling emerges at large distances for all ensembles, with a nontrivial critical exponent. A similar behavior has earlier been seen in calculations of the gluon transverse momentum spectrum, which becomes independent of the initial spectrum of gauge fields (i.e. the initial unintegrated gluon distribution) for momenta less than the saturation scale. Finally, we compare the results for the Wilson loop to the two-point correlator of magnetic fields.

Primary author(s) : LAPPI, Tuomas (University of Jyvaskyla)

Co-author(s) : DUMITRU, Adrian (Baruch College (City University of New York)); Dr. NARA, Yasushi (Akita International University)

Presenter(s) : LAPPI, Tuomas (University of Jyvaskyla)

Session Classification : Approach to equilibrium

Track Classification : Approach to Equilibrium

Contribution ID : **313** Type : **Contributed Talk**

Centrality dependence of particle production in p-A collisions measured by ALICE

Monday, 19 May 2014 16:50 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Measurements of particle production in proton-nucleus collisions provide a reference to disentangle final state effects, i.e. signatures of the formation of a deconfined hot medium, from initial state effects, already present in cold nuclear matter. While most of the benchmarks from the control experiment indicate that initial state effects do not play a role in the observed suppression of hadron production observed in heavy ion collisions, several measurements of particle production in the low and intermediate p_{T} region indicate the presence of collective effects.
Since many initial state effects are expected to vary as a function of the number of collisions suffered by the incoming projectile, it is crucial to estimate event-by-event the centrality of the collision.
We present the centrality dependence of particle production in p-A collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV measured by the ALICE experiment, including the pseudo-rapidity and transverse momentum spectra, with a special emphasis on the event classification in centrality classes and its implications in the interpretation of the nuclear effects.

Primary author(s) : Dr. TOIA, Alberica (Johann-Wolfgang-Goethe Univ. (DE))

Presenter(s) : Dr. TOIA, Alberica (Johann-Wolfgang-Goethe Univ. (DE))

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **316** Type : **Contributed Talk**

Measurement of the long-range pseudorapidity correlations and associated Fourier harmonics in 5.02 TeV proton-lead collisions with the ATLAS detector

Tuesday, 20 May 2014 15:00 (0:20)

On behalf of collaboration:

ATLAS

Abstract content

Detailed measurement of the Fourier harmonics (v_n) associated with the azimuthal modulation of two-particle correlation structures over $-5 < \delta\eta < 5$ in 31 nb^{-1} p + Pb collisions are presented. The v_n results are presented as a function of p_T, \eta, and event activity characterized by the number of reconstructed tracks in $-2.5 < \eta < 2.5$, and the total transverse energy on the Pb-going side ($3.2 < \eta < 4.9$). The elliptic, triangular, and quadrangular coefficients, v_2, v_3 and v_4, are extracted for $0.5 < p_T < 15$ GeV, significantly extending the previous measurements. The v_n values are found to reach a maximum around 3-5 GeV and then decrease to a finite positive values at $p_T > 10$ GeV, similar to the behavior seen in Pb+Pb collisions. Evidence for rapidity-even dipolar flow v_1 is also observed, further supporting a collective origin of the long-range two-particle correlations. The first measurement of the eta dependence of these correlations suggests that the v_2 values are smaller in the proton-going side than those in the Pb-going side. Finally v_n results are also extracted with four-particle cumulant method and compared with those obtained with two-particle correlation method. These results provide new important insights on the physics underlying the long-range pseudorapidity correlations.

Primary author(s) : RADHAKRISHNAN, Sooraj Krishnan (State University of New York (US))

Presenter(s) : RADHAKRISHNAN, Sooraj Krishnan (State University of New York (US))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **317** Type : **Contributed Talk**

Hydrodynamics and jets in dialogue

Tuesday, 20 May 2014 10:20 (0:20)

On behalf of collaboration:

None

Abstract content

We investigate both the medium-induced modifications of jets and the jet-induced modifications of the medium in heavy ion collisions at LHC energies with JEWEL. JEWEL is a fully microscopic Monte Carlo event generator for jet evolution in a dense medium relying on perturbative concepts, that can take any model of the medium as input. We present a detailed comparison between a full viscous hydrodynamic calculation for central events and a simplified, computationally inexpensive model. We also study the modification of the hydrodynamic expansion due to jet energy loss by extracting the local energy and momentum transfer from the jet to the medium. The latter can be used as a source term in the hydrodynamic equations and we discuss its influence.

Primary author(s) : ZAPP, Korinna Christine (CERN); FLOERCHINGER, Stefan (CERN)

Presenter(s) : ZAPP, Korinna Christine (CERN)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **319** Type : **Contributed Talk**

Lattice QCD based equation of state at finite baryon density

Tuesday, 20 May 2014 14:20 (0:20)

On behalf of collaboration:

None

Abstract content

The effects of non-zero baryon density are expected to become important in hydrodynamic modeling of heavy collisions below the highest energy at RHIC. Recent calculations in effective models and in QCD using Dyson Schwinger equation suggest that the transition in QCD remains a crossover up to baryon chemical potentials of about 800MeV [1]. If so, the equation of state relevant for hydrodynamic models can be calculated on the lattice using Taylor expansion. However, except for the coefficients of the lowest order, there are large cutoff effects in present lattice calculations for non-zero chemical potentials.
To extend our previous parametrization of the equation of state [2] to finite baryon density, we employ the continuum extrapolated lattice QCD data on Taylor expansion coefficients in order two [3], and complement them with coefficients in order four and six evaluated using p4 action [4]. To avoid large cutoff efects these coefficients are smoothly matched to those of hadron resonance gas at low temperature. Some preliminary results were reported in [5]. We also show how the hydrodynamical evolution is affected by this equation of state in the energy range relevant for SPS and the RHIC energy scan.
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Co-author(s) : PETRECZKY, Peter (BNL); SCHMIDT, Christian (University of Bielefeld)

Presenter(s) : HUOVINEN, Pasi (Johann Wolfgang Goethe-Universität)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **322** Type : **Contributed Talk**

Early isotropization of the quark-gluon plasma

Monday, 19 May 2014 14:20 (0:20)

On behalf of collaboration:

None

Abstract content

In recent years, the problem of thermalization in Heavy Ion Collision has received much attention, but has yet to be solved.
The issue is the following: on one hand, viscous hydrodynamics simulations suggest that the matter produced in such collisions (called the Quark Gluon Plasma, or QGP) behaves like a nearly perfect fluid, and does so very shortly after the collision (around 1 fm/c). Since hydrodynamics has local thermal equilibrium in its prerequisites, this tends to show that the QGP has thermalized during the very early stages of the collision. On the other hand, theoretical models (based on microscopic theories like the Color Glass Condensate, or CGC) predict that the QGP is very far from local thermal equilibrium at the initial time (among other non-thermal features, its energy-momentum tensor is very anisotropic).
One of the approaches developed to study this non-perturbative problem in QCD is a resummation scheme that amounts to averaging over classical fields, with random initial conditions given by a one loop calculation in the CGC framework.
We present here the results that we obtained by following this approach – the so-called classical statistical approximation or CSA, showing an early isotropization of the system compatible with viscous hydrodynamics. As a final remark, some recently found theoretical limitations of the CSA will be briefly mentioned.

Primary author(s) : EPELBAUM, Thomas (IPhT); GELIS, Francois

Co-author(s) : WU, Bin (FIAS)

Presenter(s) : EPELBAUM, Thomas (IPhT)

Session Classification : Approach to equilibrium

Track Classification : Approach to Equilibrium

Contribution ID : **325** Type : **Contributed Talk**

Double-parton scatterings in proton-nucleus and nucleus-nucleus collisions at the LHC

Monday, 19 May 2014 12:40 (0:20)

On behalf of collaboration:

None

Abstract content

We have derived a simple generic expression to compute the cross sections for double-parton scatterings (DPS) in high-energy proton-nucleus and nucleus-nucleus collisions as a function of the corresponding single-parton hard cross sections [1,2]. Estimates of DPS contributions at LHC energies for (i) same-sign W-boson pair production in p-Pb, and (ii) double-J/ψ production in Pb-Pb, are obtained from NLO predictions with nuclear PDF modifications for the corresponding single-parton scatterings. The first process can help determine the effective $\sigma_{\rm eff}$ parameter characterising the transverse distribution of partons in the nucleon, whereas the second one provides interesting insights on the event-by-event dynamics of J/ψ production in Pb-Pb. The expected cross sections and event rates after typical acceptance and efficiency losses, for various others DPS processes involving quarkonia, jets, and gauge bosons (γ, W, Z) will be given for p-Pb and Pb-Pb collisions at the LHC.
[1] D. d'Enterria, A. Snigirev, Phys.Lett. B718 (2013) 1395
[2] D. d'Enterria, A. Snigirev, Phys.Lett. B727 (2013) 157

Primary author(s) : D'ENTERRIA, David (CERN)

Co-author(s) : SNIGIREV, Alexandre (M.V. Lomonosov Moscow State University (RU))

Presenter(s) : D'ENTERRIA, David (CERN)

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **329** Type : **Contributed Talk**

J/ψ and Upsilon nuclear modification in A+A collisions

Wednesday, 21 May 2014 09:00 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

PHENIX presents new nuclear modification results on J/ψ in Cu+Au and U+U collisions. The recently completed analysis of the modification of J/ψ production in Cu+Au collisions at forward ($1.2 < y < 2.2$) and backward ($-2.2 < y < -1.2$) rapidity is the first measurement of the rapidity dependence of the J/ψ modification in unequal mass heavy ion collisions. Both hot and cold nuclear matter effects are expected to be asymmetric in rapidity in these collisions. The comparison of d+Au, Au+Au, U+U and Cu+Au J/ψ modifications across rapidities provides insight on the balance of cold and hot nuclear matter effects.

We also present new PHENIX centrality results on Υ(1S+2S+3S) production in p+p and Au+Au collisions. These results indicate significant suppression of the $2S$ and $3S$ states in the Quark-Gluon Plasma (QGP) environment. The results on temperature dependent heavy quarkonia production and evolution in the medium have the potential to bracket the temperature of the QGP.

Primary author(s) : DA SILVA, Cesar Luiz (Los Alamos National Lab)

Co-author(s) : Dr. COLLABORATION, PHENIX (various)

Presenter(s) : DA SILVA, Cesar Luiz (Los Alamos National Lab)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **330** Type : **Contributed Talk**

The fate of the weakly bound ψ' in p+p, d+Au, A+A collisions

Tuesday, 20 May 2014 15:00 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

We present new results of a completed analysis from PHENIX of ψ' modification at midrapidity in 200˜GeV d+Au collisions. Strong differential suppression of the ψ' relative to the J/ψ is observed. This has also been reported recently by ALICE at forward and backward rapidity in 5.0˜TeV p+Pb collisions. In all cases the differential suppression is too strong to be explained by nuclear breakup effects, due to the short nuclear crossing times. Given the observation of long range correlations in $p(d)$+A collisions at LHC and RHIC, consistent with hot matter effects, these observations raise very interesting questions about the mechanism of ψ' suppression when it is produced in a nuclear target.

In 2012, the PHENIX Collaboration installed the FVTX, a Silicon Tracker that precisely measures the pair opening angle prior to any multiple scattering in the muon arm absorber and thus provides an improved dimuon mass resolution. The FVTX also allows the ψ' to be separated from the J/ψ at forward and backward rapidity. During the 2012 data taking run, the PHENIX Collaboration collected a high statistics data sample of p+p and Cu+Au collisions. We present new results on the ψ' from this dataset.

Primary author(s) : DURHAM, J. Matthew (Los Alamos National Laboratory)

Presenter(s) : DURHAM, J. Matthew (Los Alamos National Laboratory)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **331** Type : **Contributed Talk**

Spectra of identified particles, geometry categorization and bias, and global observables in d+Au collisions

Monday, 19 May 2014 12:20 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

In this talk the transverse momentum spectra of identified particles, geometry categorization and bias, and global observables in d+Au collisions at 200 GeV are reported. In d+Au collisions, the intermediate p_T region between 2 and 5 GeV, there is a significant enhancement of the baryon to meson ratios relative to those measured in p+p collisions. The enhancement is present in d+Au collisions as well as Au+Au collisions and increases with centrality. We compare a class of peripheral Au+Au collisions with a class of central d+Au collisions which have a comparable number of participants and binary collisions. The p_T dependent ratios for these classes display a remarkable similarity. The nuclear modification of hadrons at higher transverse momentum also reveal interesting effects. Geometry selection in d+Au/p+Pb collisions is crucial for understanding the physics underlying modified nuclear parton distribution functions, gluon saturation and glasma diagrams, initial state energy loss, and possible hydrodynamic flow in these small systems. Data from the p+Pb LHC results indicate potentially large biases in the geometry determination in these small systems. The PHENIX collaboration presents tests of auto-correlation biases. Our findings indicate that these biases are an order of magnitude smaller at RHIC as compared to the LHC, and are thus well quantified. Geometry tests with neutron-tagged events and the centrality scaling of $\mathrm{d}N_{ch}/d\eta$ and $\mathrm{d}E_T/d\eta$ are presented.

Primary author(s) : CAMPBELL, Sarah (Iowa State University)

Presenter(s) : CAMPBELL, Sarah (Iowa State University)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **332** Type : **Contributed Talk**

HBT and collective flow at mid-rapidity in d+Au collisions

Wednesday, 21 May 2014 12:30 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

Recent results obtained at RHIC and the LHC have revealed the presence of unexpected collective effects in central $p(d)$+A collisions. Different techniques and physical observables have been utilized to understand whether these collective effects have a similar origin to heavy ion collisions or can be explained solely by cold nuclear matter effects. Two-pion Bose-Einstein correlation is a valuable tool for studying the space-time extent of emission sources in $p(d)$+A and A+A interactions, while the measurement of the charged particle momentum anisotropy helps in understanding of the collision collective dynamics.
In this talk we report new PHENIX results for these observables. PHENIX has extracted the 3D HBT radii as a function of centrality and transverse-pair momentum (k_T), for the d+Au and Au+Au collision systems. A comparison of the radii for both systems indicate strong similarities in the detailed dependencies on centrality and k_T, suggestive of important final-state rescattering effects in the reaction dynamics for the d+Au and Au+Au systems. The measurements also point to a smaller freeze-out size and system lifetime in d+Au as compared to Au+Au.
We also report recent PHENIX results for elliptic flow measured for charged hadrons near midrapidity in d+Au collisions that complement recent analyses by experiments at the LHC. We observe qualitatively similar, but larger, anisotropies in d+Au collisions compared to those seen in p+Pb collisions at the LHC that is consistent with expectations from hydrodynamic calculations owing to the larger expected initial-state eccentricity. The combined HBT and flow data provide significant constraints on hydrodynamic and glasma diagram explanations.

Primary author(s) : AJITANAND, Nuggehalli (Stony Brook University)

Presenter(s) : AJITANAND, Nuggehalli (Stony Brook University)

Session Classification : Correlations and fluctuations

Track Classification : Collective Dynamics

Contribution ID : **333** Type : **Contributed Talk**

Long range rapidity correlations and v_2 of identified particles in d+Au collisions

Tuesday, 20 May 2014 15:20 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

Traditionally $p(d)$+A collisions at RHIC and the LHC were considered as a tool to study cold nuclear matter effects. Production of the hot and dense medium in such collisions was not expected. However recent measurements has challenged this assumption with the observation of long-range correlations in angular distributions of hadron pairs with low transverse momentum. The observed modulations are very similar to those previously seen in A+A collisions which are widely thought to arise from hydrodynamic flow. The same hydrodynamic models used in heavy ion collisions have been successful in describing the $p(d)$+A results. However the long-range correlations observed in $p(d)$+A collisions can also be qualitatively described within the Color Glass Condensate models.

In this talk we present new PHENIX results for azimuthal angular correlations between charged hadrons measured at mid-rapidity ($|\eta| < 0.35$) and energy deposited in calorimeter towers in the Au-going direction at large rapidity ($-3.7 < \eta < -3.1$) in central d+Au collisions at $\sqrt{s_{NN}} = 200$˜GeV. We report the first direct evidence for enhanced near-side angular correlations across $|\Delta\eta| > 2.75$ at RHIC. We also present the first measurement of v_2 for identified charged pions and (anti-)protons in d+Au at RHIC, and observe a mass-ordering pattern similar to that seen in A+A collisions.

Primary author(s) : Dr. HUANG, shengli (PHENIX Collaboration)

Presenter(s) : Dr. HUANG, shengli (PHENIX Collaboration)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **335** Type : **Contributed Talk**

Centrality dependence of soft photon production and its collective flow in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV

Monday, 19 May 2014 14:20 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

Soft photons are of particular interest since they are unmodified once produced, and thus carry information about the space-time thermal properties of the medium. We present new results on the centrality dependence of soft single photons in Au+Au collisions, down to $p_T = 400$ MeV/c via photon conversions to e^+e^- pairs. These measurements provide stringent tests of the hydrodynamic space-time evolution as a detailed function of the collision geometry.

These soft photons have different angular emission patterns depending on their production mechanism. Previous published PHENIX results indicate that the second order Fourier coefficient (v_2) is postive for $p_T < 4$ GeV/c, which is qualitatively explained by hydrodynamical model calculations, but not quantitatively. The 3rd order Fourier coefficient (v_3) of photons has been proposed as a critical additional handle to understand the photon emission. Photons emitted under the presence of strong magnetic field created in the collision would have a significant influence on v_2 while very little on v_3. In contrast, hydrodynamical models predict a sizable photon v_3. We report the latest results on the centrality dependence of the soft photon production and the v_2 and v_3 coefficients in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV.

Primary author(s) : MIZUNO, Sanshiro (University of Tsukuba (JP))

Presenter(s) : MIZUNO, Sanshiro (University of Tsukuba (JP))

Session Classification : Electromagnetic probes

Track Classification : Collective Dynamics

Contribution ID : **337** Type : **Contributed Talk**

Measurement of single electrons from heavy flavor decays from p+p, d+Au, and Cu+Cu collisions in the PHENIX experiment

Monday, 19 May 2014 12:20 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

Charm and bottom quarks are formed predominantly by gluon fusion in the initial hard scatterings at RHIC, making them good probes of the full medium evolution. Previous measurements at RHIC have shown large suppression and azimuthal anisotopy of open heavy flavor hadrons in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. Explaining the simultaneously large suppression and flow of heavy quarks has been a challenge for the community. To further understand the heavy flavor transport in the hot medium, it is imperative to also measure cold nuclear matter effects which affect the initial distribution of heavy quarks as well as the system size dependence of the final state suppression. In this talk, new measurements by the PHENIX collaboration of single electrons from heavy flavor decays in p+p, d+Au, and Cu+Cu collisions at $\sqrt{s_{NN}} = 200$ GeV are presented. In particular, surprising enhancement of intermediate transverse momentum heavy flavor leptons in d+Au at mid and backward rapidity are seen to grow going to mid-central Cu+Cu collisions. This enhancement is much larger than anti-shadowing of the parton distributions and is theoretically unexplained.

Primary author(s) : LIM, Sanghoon (Yonsei University)

Presenter(s) : LIM, Sanghoon (Yonsei University)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **339** Type : **Contributed Talk**

PHENIX beam energy scan results

Tuesday, 20 May 2014 15:00 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

The Beam Energy Scan (BES) program at RHIC has shown the flexibility to vary the beam energy per nucleon by more than an order of magnitude, down to the equivalent $\sqrt{s_{NN}}$ of SPS fixed-target collisions and below. This allows the RHIC experiments to systematically track the evolution of excited nuclear matter as it crosses the QGP transition, and to explore new physics at significant net baryon density such as the possibility of a QCD critical point at high μ_B. We present new results from PHENIX on the beam-energy dependence of observables including hydrodynamic flow parameters, 3D HBT source shapes, and global multiplicity and E_T production. We also discuss plans to utilize the upcoming BES-II running period at RHIC.

Primary author(s) : Dr. SOLTZ, Ron (Lawrence Livermore Nat. Laboratory (US))

Presenter(s) : Dr. SOLTZ, Ron (Lawrence Livermore Nat. Laboratory (US))

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **341** Type : **Contributed Talk**

Emission angle and particle mass dependence of HBT Interferometry in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV

Wednesday, 21 May 2014 12:10 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

The initial density distribution in a heavy ion collision fluctuates due to the finite number of participating nucleons, which leads to higher harmonic flow as recently measured at RHIC and the LHC. Such spatial fluctuations may be preserved until kinetic freeze-out, depending on the strength of the initial fluctuations, the flow profile, the expansion time, and viscosity of the created matter.
Hanbury Brown and Twiss (HBT) interferometry is a powerful tool to study the space-time extent of a particle emitting source in heavy ion collisions. PHENIX has measured the azimuthal angle dependence of HBT radii with respect to the 2nd and 3rd-order event planes in Au+Au collisions at $\sqrt{s_{NN}} = 200$˜GeV.
The results for the 2nd-order dependence indicate that the initial eccentricity is reduced during the medium evolution, but not reversed in the final state, which is consistent with previous results. In contrast, the results for the 3rd-order dependence indicate that the initial triangular shape is signicantly reduced and potentially reversed by the end of the medium evolution, and that the 3rd-order oscillations are largely dominated by the dynamical effects from triangular flow. The measurement of the HBT radii from different particle correlations such as charged kaons over the wide m_T ranges give deeper insight on the emission source dynamics. We will report and discuss these new comprehensive HBT measurement in Au+Au collisions at $\sqrt{s_{NN}} = 200$˜GeV.

Primary author(s) : ESUMI, Shinichi (University of Tsukuba (JP))

Presenter(s) : ESUMI, Shinichi (University of Tsukuba (JP))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **343** Type : **Contributed Talk**

Transverse energy distributions at mid-rapidity in p+p, d+Au, and Au+Au collisions at $\sqrt{s_{NN}}$ =62.4–200 GeV and implications for particle production models

Monday, 19 May 2014 11:20 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

Measurements of the midrapidity transverse energy distribution $dE_T/d\eta$, are presented for p+p, d+Au, and Au+Au collisions at 62.4–200 GeV. The E_T distributions are compared with the number of participants, $N_{\rm part}$, the number of binary collisions, $N_{\rm coll}$, and the number of constituent-quark participants, N_{qp}, calculated from a Glauber model. For Au+Au, $(dE_T/d\eta)/N_{\rm part}$ indicates that the two component ansatz $dE_T/d\eta$ $(1-x)N_{\rm part}/2 + xN_{\rm coll}$, which has been used to explain E_T distributions is simply a proxy for N_{qp}, and that the $N_{\rm coll}$ term does not represent a hard-scattering component in E_T distributions. The $dE_T/d\eta$ distributions of Au+Au and d+Au are then calculated from the measured p+p E_T distributions using two models (additive quark model and the number-of-constituent quarks model) that both reproduce the Au+Au data. However, the number-of-constituent-quark-participant model agrees well with the d+Au data, while the additive quark model does not. A description of the various models and their implications will be discussed.

Primary author(s) : TANNENBAUM, Michael (Brookhaven National Laboratory (US))

Presenter(s) : TANNENBAUM, Michael (Brookhaven National Laboratory (US))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **348** Type : **Contributed Talk**

Heavy quark physics measurements with the PHENIX Detector

Monday, 19 May 2014 11:20 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

In heavy ion collisions at RHIC, heavy quarks are produced predominantly in the initial hard scatterings and thus probe the entire lifetime of the hot and dense medium. Additionally, measuring charm and beauty quarks allows us to study the mass dependence of energy loss, constraining the transport properties of the Quark-Gluon Plasma. Previous measurements at RHIC have shown large suppression and azimuthal anisotopy of open heavy flavor hadrons. In order to further constrain medium properties using heavy flavor probes, the interaction of charm and beauty quarks must be measured separately. PHENIX presents new results on heavy quark physics via single leptons, dilelectron correlations, electron-muon correlations, and tagging with displaced vertices.

Primary author(s) : DION, Alan (Stony Brook University)

Presenter(s) : DION, Alan (Stony Brook University)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **349** Type : **Contributed Talk**

Flow in Cu+Au collisions and unique tests of 3D medium evolution

Monday, 19 May 2014 17:10 (0:20)

On behalf of collaboration:

PHENIX

Abstract content

Cu+Au collisions at RHIC have provided the first asymmetric heavy-ion collisions at collider energies, where it is generally believed that nuclear matter above the Quark-Gluon Plasma (QGP) transition is created. The Cu+Au system provides a unique arena for QGP production and development with novel features that are inaccessible in symmetric A+A collisions, such as intrinsic transverse triangularity at mid-centrality and a completely occluded, corona-less smaller nucleus in the most central collisions. Further, because the participant nucleon groups from the two nuclei are distinguishably different it may be possible to trace the sources of initial deposition of such conserved quantities as energy and transverse momentum in 3D across the medium. In this talk we present new PHENIX results on flow observables from Cu+Au collisions across both p_T and (pseudo)rapidity, and discuss how they can be used to diagnose the full three-dimensional formation and evolution of the QGP fluid.

Primary author(s) : NAKAGOMI, Hiroshi (Tsukuba University)

Presenter(s) : NAKAGOMI, Hiroshi (Tsukuba University)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **350** Type : **Contributed Talk**

What the collective flow excitation function can tell about the quark-gluon plasma

Wednesday, 21 May 2014 10:00 (0:20)

On behalf of collaboration:

None

Abstract content

The midrapidity slope $\mathrm{d}v_1/\mathrm{d}y$ of the directed flow v_1 has been predicted to be sensitive to the possible first-order phase transition between the hadron gas and the quark-gluon plasma. The recent STAR data from the RHIC beam energy scan (BES) show that the net-proton $\mathrm{d}v_1/\mathrm{d}y$ changes sign twice within the collision energy range 7.7 - 39 GeV. To further investigate this phenomenon, we study the collision energy dependence of v_1 utilizing a Boltzmann + hydrodynamics hybrid model. Such a hybrid approach provides a natural framework for the transition from high collision energies, where the hydrodynamical description is essential, to smaller energies, where the hadron transport dominates. Calculation with dynamically evolved initial and final state shows no qualitative difference between an equation of state with cross-over and one with first-order phase transition [1], in contrast to the earlier pure fluid predictions.

We have also investigated the energy evolution of the elliptic flow v_2 and triangular flow v_3 [2]. The v_2 analysis shows that pre-equilibrium transport dynamics are partially compensating for the diminished elliptic flow production in the hydrodynamical phase at lower energies, resulting to relatively weak collision energy dependence which is in qualitative agreement with STAR BES results. The medium described by transport is, however, too viscous to build up triangular flow, making v_3 the clearer signal for the formation of (near-)ideal fluid in relativistic heavy ion collisions.

References: [1] J. Steinheimer, J. Auvinen, H. Petersen, M. Bleicher and H. Stocker, work in progress; [2] J. Auvinen and H. Petersen, Phys. Rev. C88, 064908 (2013).

Primary author(s) : Dr. AUVINEN, Jussi (Frankfurt Institute for Advanced Studies)

Co-author(s) : PETERSEN, Hannah; STEINHEIMER, Jan

Presenter(s) : Dr. AUVINEN, Jussi (Frankfurt Institute for Advanced Studies)

Session Classification : Correlations and fluctuations

Track Classification : Collective Dynamics

Contribution ID : **353** Type : **Contributed Talk**

Free energy versus internal energy potential for heavy quark systems at finite temperature

Tuesday, 20 May 2014 10:20 (0:20)

On behalf of collaboration:

None

Abstract content

Using the QCD sum rule with its operator product expansion reliably determined from lattice calculations for the pressure and energy density of hot QCD matter, we calculate the strength of the J/ψ wave function at origin and find that it decreases with temperature when the temperature is above the transition temperature. This result is shown to follow exactly that obtained from the solution of the Schr\"odinger equation for a charm and anticharm quark pair with temperature independent quark mass using the free energy from lattice calculations as the potential and is in sharp contrast to that using the deeper potential associated with the internal energy, which shows an enhanced strength of the J/ψ wave function at origin. Our result thus suggests that the free energy potential from lattice calculations is the appropriate heavy quark potential for analyzing the charmonium spectrum at finite temperature.

Primary author(s) : Prof. LEE, Su Houng (Yonsei University)

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Presenter(s) : Dr. SONG, Taesoo (Frankfurt Institute of Advanced Studies)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **354** Type : **Contributed Talk**

Elastic and radiative heavy quark energy loss within a transport model

Monday, 19 May 2014 14:20 (0:20)

On behalf of collaboration:

None

Abstract content

The full space-time evolution of heavy quarks and light partons in ultra-relativistic heavy-ion collisions is studied within the partonic transport model Boltzmann Approach to MultiParton Scatterings (BAMPS). We discuss in detail for all flavors the influence of elastic and radiative energy loss with a running coupling. Radiative processes, in particular, are implemented through an improved version of the Gunion-Bertsch matrix element, which is derived from comparisons to the exact result. In this calculation the finite heavy quark masses are explicitly taken into account, leading to the dead cone effect. Consequently, we present results of this updated version of BAMPS and compare them to experimental data at RHIC and LHC. In detail, the nuclear modification factor and elliptic flow of charged hadrons, heavy flavor electrons as well as muons, D mesons, and non-prompt J/psi are discussed. The latter two are especially sensitive to the mass difference of charm and bottom quarks. Furthermore, we make predictions where no data is available yet.

Primary author(s) : UPHOFF, Jan (Goethe University Frankfurt)

Co-author(s) : XU, Zhe; GREINER, Carsten (University of Frankfurt)

Presenter(s) : UPHOFF, Jan (Goethe University Frankfurt)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **359** Type : **Contributed Talk**

Probing the non-equilibrium dynamics of hot and dense QCD with dileptons

Monday, 19 May 2014 15:40 (0:20)

On behalf of collaboration:

None

Abstract content

Much work has been devoted to the determination of an effective value of the shear viscosity coefficient from analyses of the hadronic final states in relativistic heavy-ion collisions. Electromagnetic radiation, however, constitutes a class of complementary and penetrating probes that are sensitive to the entire space-time history of nuclear collisions including its very early stages. We show that thermal dileptons (and photons) are affected by the transport properties of the fluid and by the non-equilibrium aspects of the initial state that are usually inaccessible to hadronic probes. For the first time, we explicitly demonstrate that electromagnetic spectra and azimuthal momentum anisotropy can be used not only to investigate the magnitude of the shear relaxation time and to differentiate between possible initial shear-stress tensors, but also to reveal the temperature dependence of the shear viscosity coefficient. We further show that the dependence of electromagnetic probes on these quantities comes mostly from processes occurring in the QGP phase. Our approach utilizes event-by-event 3+1D viscous hydrodynamic simulations (MUSIC) [1], and the dilepton emission sources include contributions from charm decay and hadronic rates extracted from in-medium spectral functions [2].
[1] Bjoern Schenke, Sangyong Jeon, Charles Gale, Phys.Rev. C82 (2010) 014903
[2] Gojko Vujanovic, Clint Young, Bjoern Schenke, Ralf Rapp, Sangyong Jeon, and Charles Gale, arXiv:1312.0676, PRC in press.

Primary author(s) : VUJANOVIC, Gojko (McGill University)

Co-author(s) : DENICOL, Gabriel (McGill University); YOUNG, Clint (University of Minnesota); Dr. SCHENKE, Bjoern (Brookhaven National Lab); LUZUM, Matthew (McGill/LBNL); JEON, Sangyong (McGill University); GALE, Charles (McGill University)

Presenter(s) : VUJANOVIC, Gojko (McGill University)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **368** Type : **Contributed Talk**

The QCD Equation of State at $\mathcal{O}(^{-4}_{\mathbf{B}})$

Tuesday, 20 May 2014 11:50 (0:20)

On behalf of collaboration:

None

Abstract content

Hydrodynamic models of heavy-ion collisions have increasingly begun to rely on lattice results for the Equation of State[1]. While the lattice has the advantage of being a first-principles approach to QCD, the notorious sign problem prevents a direct determination of the equation of state and other thermodynamic observables at finite baryon chemical potential μ_B.
In our talk, we will present results from a high-statistics calculation of all the Taylor coefficients upto sixth order in a (μ_B, μ_Q, μ_S)-expansion of the pressure. Our calculation allows us to extrapolate, for the first time, the equation of state on the freezeout curve upto $\mathcal{O}(\mu_B^4)$ while our sixth-order results show that the truncation error is not more than a few % upto $\mu_B/T \sim 1.5$. Thus our equation of state should be useful in describing both the LHC results as well as results from RHIC beam energy scan down to ∼20 GeV. We will also use our results to construct the isentropic equation of state for strangeness-neutral systems.
Our lattice QCD calculations make use of the gauge ensembles generated using the HISQ action[2,3]. Our lattice sizes range from 6×24^3 to 12×48^3. The pion mass (∼160 MeV) is nearly equal to its physical value while the strange quark mass has been set to exactly its physical value.

References

[1] See for e.g. C. Gale, S. Jeon and B. Schenke, Int. J. Mod. Phys. **A28**, 1340011 (2013); C. Shen, U. Heinz, P. Huovinen and H. Song, Phys. Rev. **C82**, 054904 (2010).
[2] A. Bazavov *et al.* [HotQCD Collaboration], Phys. Rev. **D86**, 035409 (2012).
[3] A. Bazavov, H.-T. Ding, P. Hegde, O. Kaczmarek, F. Karsch, E. Laermann, Y. Maezawa, S. Mukherjee, H. Ohno, P. Petreczky, C. Schmidt, S. Sharma, W. Soeldner and M. Wagner, Phys. Rev. Lett. **111**, 082301 (2013).

Primary author(s) : Dr. HEGDE, Prasad (Central China Normal University)

Presenter(s) : Dr. HEGDE, Prasad (Central China Normal University)

Session Classification : QCD at high temperature and/or density

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **371** Type : **Contributed Talk**

Initial state geometry and fluctuations in deformed and asymmetric nuclear collisions in the IP-Glasma framework

Monday, 19 May 2014 11:40 (0:20)

On behalf of collaboration:

None

Abstract content

The IP-Glasma model of initial conditions based on the *ab initio* color glass condensate (CGC) framework successfully explains the bulk features of global data for various systems like p+p, p+A and A+A over a wide range of energies [1-3]. We employ this framework to study deformed U+U collisions, asymmetric Cu+Au collisions and the effect of deformation in Au+Au collisions at RHIC. A combined study of these heavy ion systems with varying initial geometries can provide a unique opportunity to determine the origin of different sources of fluctuations that affect global observables like multiplicity and flow. We study the sensitivity of multiplicity, eccentricity and their event-by-event distributions to the details of initial state geometry. Results are compared to a two component MC-Glauber model implementation that includes Negative-Binomial multiplicity fluctuations. We argue that measurements of global observables for these systems at RHIC can constrain the mechanism of multi-particle production [4].

Ref :
[1]B .Schenke, P. Tribedy, R. Venugopalan, Phys. Rev. Lett. 108 (2012) 252301, Phys.Rev. C89 (2014) 024901.
[2]C. Gale, S. Jeon, B. Schenke, P. Tribedy, R. Venugopalan, Phys.Rev.Lett. 110 (2013) 012302.
[3]A. Bzdak, B. Schenke, P. Tribedy, R. Venugopalan, Phys. Rev. C 87, 064906 (2013).
[4]B .Schenke, P. Tribedy, R. Venugopalan *in preparation*

Primary author(s) : TRIBEDY, Prithwish (VECC)

Co-author(s) : Dr. SCHENKE, Bjoern (Brookhaven National Lab); VENUGOPALAN, Raju (Brookhaven National Laboratory)

Presenter(s) : TRIBEDY, Prithwish (VECC)

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **372** Type : **Contributed Talk**

Gluon transport equation in the small-angle approximation and the onset of Bose-Einstein condensation

Monday, 19 May 2014 15:40 (0:20)

On behalf of collaboration:

None

Abstract content

To understand the evolution of a dense system of gluons, such as those produced in the early stages of ultra-relativistic heavy ion collisions, is an important and challenging problem. We describe the approach to thermal equilibrium using the small angle approximation for gluon scattering in a Boltzmann equation that includes the effects of Bose statistics. The role of Bose statistical factors in amplifying the rapid growth of the population of the soft modes is essential. With these factors properly taken into account, one finds that elastic scattering alone provides an efficient mechanism for populating soft modes, and in fact leads to rapid infrared local thermalization.

Furthermore recent developments suggest that high initial overpopulation plays a key role and may lead to dynamical Bose-Einstein Condensation. The kinetics of condensation is an interesting problem in itself. By solving the transport equation for initial conditions with a large enough initial phase-space density the equilibrium state contains a Bose condensate, and we present numerical evidence that such over-populated systems reach the onset of Bose-Einstein condensation in a finite time. It is also found that the approach to condensation is characterized by a scaling behavior. Finally we discuss a number of extensions of the present study.

Reference: Blaizot, Liao, McLerran, Nucl. Phys. A920(2013)58.

Primary author(s) : BLAIZOT, Jean-Paul (CEA Saclay); LIAO, Jinfeng (Indiana University); MCLERRAN, Larry (BNL)

Presenter(s) : LIAO, Jinfeng (Indiana University)

Session Classification : Approach to equilibrium

Track Classification : Approach to Equilibrium

Contribution ID : **378** Type : **Contributed Talk**

Spectral functions from the functional renormalization group

Tuesday, 20 May 2014 15:40 (0:20)

On behalf of collaboration:

None

Abstract content

We present a new method to obtain real-time quantities such as spectral functions and transport coefficients at finite temperature and density using a non-perturbative Functional Renormalization Group approach [1].
Our method is based on a thermodynamically consistent truncation of the flow equations for 2-point functions with analytically continued frequency components in the originally Euclidean external momenta. We demonstrate the feasibility of our method by calculating the mesonic spectral functions in the quark-meson model at different temperatures and values of the quark chemical potential, in particular near the critical endpoint of the corresponding phase diagram.
[1] Tripolt, Strodthoff, von Smekal, Wambach, Phys. Rev. D 89, 034010 (2014)

Primary author(s) : TRIPOLT, Ralf-Arno (TU Darmstadt)

Co-author(s) : Dr. STRODTHOFF, Nils (Ruprecht-Karls-Universität Heidelberg); Prof. VON SMEKAL, Lorenz (Justus-Liebig-Universität Giessen and TU Darmstadt); Prof. WAMBACH, Jochen (TU Darmstadt and GSI)

Presenter(s) : TRIPOLT, Ralf-Arno (TU Darmstadt)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **382** Type : **Contributed Talk**

Measurements of dileptons with the CBM-Experiment at FAIR

Monday, 19 May 2014 18:10 (0:20)

On behalf of collaboration:

CBM

Abstract content

The Compressed Baryonic Matter (CBM) experiment at the upcoming Facility for Antiproton and Ion Research (FAIR) will explore the phase diagram of nuclear matter at very high net-baryon densities and moderate temperatures in nucleus-nucleus collisions at beam energies up to 45 A GeV . One of the key diagnostic probes of strongly-interacting matter at extreme conditions are dileptons. Dilepton measurements performed so far in heavy-ion collisions at various energies have found that the major challenge is to subtract the combinatorial background which overwhelms the interesting signals such as the rho spectral distribution, direct radiation from the fireball at intermediate invariant masses, and charmonia. This background is of different physical origin for dielectron and dimuons, and differs as function of invariant mass. Therefore, the systematic and statistical errors of the extracted signals will be substantially minimized by measuring both electron and muon pairs. The CBM detector is designed as a multi-purpose device which will be able to measure hadrons, electrons and muons in heavy-ion collisions. Electrons will be measured using a Ring Imaging Cherenkov (RICH) detector in combination with a Transition Radiation Detector. For muon measurements, the RICH detector will be replaced by a large area Muon detection system consisting of alternating layers of hadron absorbers and tracking chambers. The results of performance studies and the status of the detector developments will be presented.

Primary author(s) : HOEHNE, Claudia (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Presenter(s) : HOEHNE, Claudia (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE))

Session Classification : Electromagnetic probes

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **385** Type : **Contributed Talk**

Beam energy dependence of dielectron production in Au+Au collisions from STAR at RHIC

Monday, 19 May 2014 11:00 (0:20)

On behalf of collaboration:

STAR

Abstract content

Bulk-penetrating dielectrons allow for the extraction of direct information from all stages of a heavy ion collision as they serve as electromagnetic probes with negligible final-state interactions. The completion of the Barrel Time-of-Flight detector (TOF) in 2010 has allowed the Solenoid Tracker At RHIC (STAR) to play a unique role in the study of dielectron production with excellent particle identification, low material budget, full azimuthal acceptance at mid-rapidity, and a wide momentum coverage. In combination with the Beam Energy Scan (BES) conducted at RHIC, in particular, STAR presents the unprecedented opportunity to map out a significant portion of the QCD phase diagram within a homogeneous experimental environment. In the quest for a better understanding of strongly interacting nuclear matter the Low-Mass Region (LMR, $M_{ee} < 1.1$ GeV/c^2) of dielectron spectra, on the one hand, provides information about in-medium modifications of the ρ-meson's properties. The Intermediate-Mass Region (IMR, $1.1 < M_{ee} < 3$ GeV/c^2), on the other hand, can provide access to the initial Quark-Gluon Plasma (QGP) temperature as well as a possibly medium-modified correlated charm continuum.

In this talk, we will present the energy-dependent study of dielectron production at $\sqrt{s_{NN}}$ of 19.6, 27, 39, and 62.4 GeV. M_{ee} and p_T differential measurements of LMR mass distributions are compared to cocktail simulations of known hadronic sources. The excess yield is further compared to calculations of ρ in-medium modifications. Properties of IMR spectral data will be compared to simulations of semi-leptonic charmed decays.

Primary author(s) : Mr. HUCK, Patrick (LBNL/CCNU)

Presenter(s) : Mr. HUCK, Patrick (LBNL/CCNU)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **389** Type : **Contributed Talk**

Recent STAR measurements of J/ψ production from Beam Energy Scan and U+U collisions

Tuesday, 20 May 2014 09:40 (0:20)

On behalf of collaboration:

STAR

Abstract content

J/ψ suppression in heavy-ion collisions due to color screening of quark and antiquark potential in the deconfined medium has been proposed as a signature of the QGP formation. Other mechanisms, such as the cold nuclear matter effect and charm quark recombination, are likely to contribute to the observed modification of J/ψ production in heavy-ion collisions. Measurements of J/ψ invariant yields in different collision energies, collision systems, and centralities can shed new light on the interplay of these mechanisms for J/ψ production and medium properties.

In this presentation we report on new measurements of J/ψ production at midrapidity ($|y| < 1.0$) from the Beam Energy Scan program (Au+Au collisions at $\sqrt{s_{NN}} = 39$ GeV and 62.4 GeV) and U+U collisions at $\sqrt{s_{NN}} = 193$ GeV at STAR. Centrality and transverse momentum dependence of J/ψ invariant yields and the nuclear modification factor (R_{AA}) will be presented and compared to those for Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV and to model calculations. The energy dependence of J/ψ suppression will be discussed.

Primary author(s) : ZHA, Wangmei (USTC/BNL)

Presenter(s) : ZHA, Wangmei (USTC/BNL)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **391** Type : **Contributed Talk**

Renormalization of the jet-quenching parameter

Wednesday, 21 May 2014 13:10 (0:20)

On behalf of collaboration:

None

Abstract content

In the context of the recently derived probabilistic picture of in-medium jet evolution, arXiv:1311.5823 [hep-ph], we study radiative corrections which yield potentially large double logarithms, $\alpha_s ln^2 L$, for large enough medium length L (arXiv:1304.7677 [hep-ph]). We show in particular that, due to a large separation of time scales, these corrections can be reabsorbed in a renormalization of the jet-quenching parameter, $\hat{q}$, in both the collision rate and radiative rate, preserving the probabilistic picture. As a major consequence of this analysis, the new renormalized quenching parameter is enhanced compared to the standard perturbative estimate. This yields in particular an increase of radiative energy loss of a fast parton traversing a QCD medium, which scales as $L^{2+\gamma}$ where the anomalous dimension $\gamma = 2\sqrt{N_c \alpha_s/\pi}$, as compared to the standard estimate that yields a scaling in L^2.

Primary author(s) : MEHTAR-TANI, yacine (IPhT CEA/Saclay)

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Presenter(s) : MEHTAR-TANI, yacine (IPhT CEA/Saclay)

Session Classification : Jets

Track Classification : New Theoretical Developments

Contribution ID : **392** Type : **Contributed Talk**

From conserved charge fluctuations to the QCD critical point

Wednesday, 21 May 2014 12:30 (0:20)

On behalf of collaboration:

None

Abstract content

Higher order cumulants of fluctuations of conserved charges are an important diagnostic tool for the thermodynamic properties of strong interacting matter close to freeze out [1] at LHC energies as well as in the entire energy range covered with the beam energy scan (BES) at RHIC. We present recent progress on the calculation of conserved charge fluctuations with highly improved staggered quarks (HISQ action). In particular we will focus on higher order cumulants up to 6th order of net baryon number, net electric charge and net strangeness fluctuations. We will discuss how these quantities approach the hadron resonance gas at low temperatures, the perturbative limit at high-T [2] and analyze to what extent they show sensitivity to universal scaling behavior, *i.e.* we estimate the relative strength of contributions from the regular and singular part of the free energy. Based on this analysis we discuss consequences for the QCD phase diagram and the radius of convergence of the Taylor expansion of the QCD partition function. The latter can be used to locate the QCD critical point. Furthermore, we comment on the signature of the QCD critical point in various ratios of conserved charge fluctuations that are measured in the BES at RHIC.

References

1. A. Bazavov, H.-T. Ding, P. Hegde, O. Kaczmarek, F. Karsch, E. Laermann, S. Mukherjee and P. Petreczky, C. Schmidt, D. Smith, W. Soeldner and M. Wagner, *"Freeze-out Conditions in Heavy Ion Collisions from QCD Thermodynamics,"* Phys. Rev. Lett. **109** (2012) 192302 [arXiv:1208.1220 [hep-lat]].
2. A. Bazavov, H.-T. Ding, P. Hegde, F. Karsch, C. Miao, S. Mukherjee, P. Petreczky and C. Schmidt and A. Velytsky, *"Quark number susceptibilities at high temperatures,"* Phys. Rev. **D88** (2013) 094021 [[arXiv:1309.2317 [hep-lat]].

Primary author(s) : SCHMIDT, Christian (University of Bielefeld)

Presenter(s) : SCHMIDT, Christian (University of Bielefeld)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **395** Type : **Contributed Talk**

Differential HBT method to analyse rotation in heavy ion collisions

Wednesday, 21 May 2014 10:20 (0:20)

On behalf of collaboration:

None

Abstract content

With increasing beam energies the angular momentum of the fireball in peripheral heavy ion collisions is increasing. The earlier predicted rotation effect and Kelvin Helmholtz Instability, leads to space-time momentum correlations among the emitted particles. For these reactions two particle correlations are studied. A specific combination of two particle correlation measurements is proposed, the Differential Hanbury Brown and Twiss method, which can sensitively detect the rotation of the emitting system. In case of azimuthally symmetric systems without rotation the new method gives zero signal, while it is sensitive to the rotation in the system. The method is studied in simple models and in numerical fluid dynamic model results.

The talk is based on recent results and the following publications: [1] L.P. Csernai, D.D.Strottman and C. Anderlik, Phys. Rev. C 85, 054901 (2012). [2] L.P. Csernai, V.K. Magas and D.J. Wang, Phys. Rev. C 87, 034906 (2013). [3] L.P. Csernai, S. Velle, (2013) arXiv:1305.0385 [4] L.P. Csernai, S. Velle and D.J. Wang, arXiv:1305.0396

Primary author(s) : CSERNAI, Laszlo (Department of Physics and Technology)

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Presenter(s) : CSERNAI, Laszlo (Department of Physics and Technology)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **396** Type : **Contributed Talk**

Photonuclear production of vector mesons in ultra-peripheral Pb-Pb collisions at the LHC

Monday, 19 May 2014 12:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Vector mesons are copiously produced in ultra-peripheral nucleus-nucleus collisions. In these collisions, the nuclei are separated by impact parameters larger than the sum of the nuclear radii, and the interaction is mediated by the electromagnetic field. The interaction effectively corresponds to a photonuclear interaction between a photon, generated from the electromagnetic field of one of the nuclei, and the target nucleus. The ALICE Collaboration has previously published results on exclusive J/ψ photoproduction at mid and forward rapidities in Pb-Pb collisions. The cross section for this process is a particularly good measure of the nuclear gluon distribution. In this talk, the latest results on exclusive production of light and heavy vector mesons from ALICE in Pb-Pb collisions will be presented.

Primary author(s) : NYSTRAND, Joakim (University of Bergen (NO))

Presenter(s) : NYSTRAND, Joakim (University of Bergen (NO))

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **397** Type : **Contributed Talk**

Heavy ions collision evolution modeling with ECHO-QGP

Tuesday, 20 May 2014 10:20 (0:20)

On behalf of collaboration:

None

Abstract content

We present a numerical code for modeling relativistic heavy ion collisions, ECHO-QGP. The code includes relativistic hydrodynamics with dissipative terms and implements Israel-Stewart theory in 3+1 D. Initial conditions are provided through an implementation of the Glauber model (both Optical and Monte Carlo), while freezeout and particle generation is based on the Cooper-Frye prescription. ECHO-QGP features dynamical metric tensor in a GR framework for ideal hydro and it can work in Bjorken and cartesian frames for the dissipative case. The code shows remarkable stability and accuracy with the combination of a conservative (shock-capturing) approach with the high-order methods. ECHO-QGP is able to reproduce several known solutions of ideal and dissipative hydrodynamics including the lately proposed Gubser test.
Ref. L. Del Zanna, V. Chandra, G. Inghirami, V. Rolando, A. Beraudo, A. De Pace, G. Pagliara, A. Drago and F. Becattini, *"Relativistic viscous hydrodynamics for heavy-ion collisions with ECHO-QGP"* Eur. Phys. J. C **73**, 2524 (2013)

Primary author(s) : Ms. ROLANDO, Valentina (Università di Ferrara, INFN Ferrara); BERAUDO, Andrea (Universidade de Santiago de Compostela (ES)); CHANDRA, Vinod (INFN Florence Italy); BECATTINI, Francesco (Unversity of Florence); INGHIRAMI, Gabriele (Università di Firenze, INFN Firenze); DEL ZANNA, Luca (Università di Firenze, INAF Firenze, INFN Firenze); DE PACE, Arturo (INFN Torino); DRAGO, Alessandro; PAGLIARA, giuseppe

Presenter(s) : Ms. ROLANDO, Valentina (Università di Ferrara, INFN Ferrara)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **399** Type : **Contributed Talk**

Signatures of collective behavior in small systems

Wednesday, 21 May 2014 09:20 (0:20)

On behalf of collaboration:

JET

Abstract content

We perform 3+1D viscous hydrodynamic calculations of proton-nucleus and nucleus-nucleus collisions. The goal is to ascertain the nature of the striking correlations seen in recent proton-nucleus collisions. In particular, one would like to know: is the observed ridge a signature of collective behavior? Can the highest multiplicity collision systems be accurately described as a relativistic fluid? If so, at what point does hydrodynamics fail to describe the bulk evolution?
To this end, we propose to measure the detailed transverse momentum structure of two-particle correlations. They must satisfy rigid inequality relations in any hydrodynamic system, and within those bounds we show that they should have a particular dependence on multiplicity over the entire measured centrality range. Any deviation from this behavior would signal a breakdown of a hydrodynamic description. We also show how a simultaneous description of Pb-Pb and p-Pb data can put a significant constraint on theoretical models. Finally, we compare our calculations to the full set of existing measurements, demonstrating what parameters are required for a good fit to data and commenting on what can be learned.

Primary author(s) : KOZLOV, Igor (McGill University); LUZUM, Matthew (McGill / LBNL)

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Presenter(s) : KOZLOV, Igor (McGill University)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **405** Type : **Contributed Talk**

Towards continuum results of the heavy quark momentum diffusion coefficient

Tuesday, 20 May 2014 15:40 (0:20)

On behalf of collaboration:

None

Abstract content

Among quantities playing a central role in the theoretical interpretation of heavy ion collision experiments at RHIC and LHC are so-called transport coefficients. Out of those heavy quark diffusion coefficents play an important role e.g. for the analysis of the quenching of jets containing c or b quarks (D or B mesons) as observed at RHIC and LHC.
We report on a lattice investigation of heavy quark momentum diffusion within pure SU(3) plasma above the deconfinement transition, with the quarks treated to leading order in the heavy mass expansion. We measure the relevant "colour-electric" Euclidean correlator and based on several lattice spacings perform the continuum extrapolation. This extends our previous study [1,2] progressing towards a removal of lattice artifacts and a physical interpretation of the results.
We find that the correlation function clearly exceeds its perturbative counterpart which suggests that at temperatures just above the critical one, non-perturbative interactions felt by the heavy quarks are stronger than within the weak-coupling expansion. Our results will be compared to heavy quark diffusion coefficients [3] obtained from charmonium vector correlation functions.
[1] A. Francis, O. Kaczmarek, M. Laine, M. Müller, T. Neuhaus and H. Ohno, "Towards the continuum limit in transport coefficient computations", arXiv:1311.3759.
[2] A. Francis, O. Kaczmarek, M. Laine and J. Langelage, "Towards a non-perturbative measurement of the heavy quark momentum diffusion coefficient", arXiv:1109.3941.
[3] H.T. Ding, A. Francis, O. Kaczmarek, F. Karsch, H. Satz and W. Soeldner, "Charmonium properties in hot quenched lattice QCD", Phys.Rev.D86 (2012) 014509, arXiv:1204.4945.

Primary author(s) : Dr. KACZMAREK, Olaf (University of Bielefeld)

Presenter(s) : Dr. KACZMAREK, Olaf (University of Bielefeld)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **409** Type : **Contributed Talk**

Measurement of jet p_{T} spectra and R_{AA} in pp and Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV with the ALICE detector

Tuesday, 20 May 2014 09:40 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Hard-scattered partons provide an ideal probe for the study of the Quark-Gluon Plasma because they are produced prior to the formation of the QCD medium in heavy-ion collisions. Early measurements conducted at RHIC experiments have provided compelling evidence of jet quenching. In more recent years LHC experiments have confirmed these observations at a higher collisional energy, which allows full jet reconstruction over a much wider kinematic range. Jets are reconstructed in ALICE utilizing both the central tracking system for the charged constituents and the Electromagnetic Calorimeter for the neutral constituents. One of the most important challenges of jet reconstruction in heavy-ion collisions is the large fluctuating background energy density coming from the underlying event. A data-driven method has been used to correct for it which, combined with the unfolding of the detector effects, makes it possible to compare with other experimental results and theoretical predictions. Jet spectra will be reported for Pb-Pb and for pp collisions at a center of mass energy of 2.76 ATeV. The pp measurement serves also as the baseline for the determination of the nuclear modification factor, which shows a strong suppression of jet production in central Pb-Pb collisions. Differential measurements relative to the event plane and centrality class, which make use of data triggered by the Electromagnetic Calorimeter, will aid further investigation of details of this suppression, e.g. regarding the path length dependence of parton energy loss.

Primary author(s) : AIOLA, Salvatore (Yale University (US))

Presenter(s) : AIOLA, Salvatore (Yale University (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **413** Type : **Contributed Talk**

Will perfect fluidity of the sQGP survive in light of the BES & D+Au & p+Au data?

Monday, 19 May 2014 18:10 (0:20)

On behalf of collaboration:

None

Abstract content

Recent low pT<2 GeV vn data on the beam energy scan (BES) and D+Au at RHIC and the surprising data on low pT vn in p+Pb at LHC challenge long held assumptions about the validity or necessity of perfect fluid hydrodynamics in A+A. Could classical field interference phenomena from color antenna arrays and or Unruh noninertial color currents play a critical role in resolving the BES+DA+pA puzzle? We explore non-hydrodynamic scenarios that could generate apparent collective flow signatures in vn observables.

Primary author(s) : Prof. GYULASSY, Miklos (Columbia University)

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Presenter(s) : Prof. GYULASSY, Miklos (Columbia University)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **414** Type : **Contributed Talk**

Measurement of hadron composition in charged jets from pp collisions with the ALICE experiment

Tuesday, 20 May 2014 14:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Jets are defined in QCD as cascades of consecutive emission of partons from an initial hard scattering. The process of parton showering and subsequent hadronisation is broadly known as fragmentation. Identified particles in the final state provide an enhanced sensitivity to the flavor dependence of fragmentation.

ALICE at the CERN LHC is a general-purpose heavy ion experiment designed to study the physics of strongly interacting matter. It provides excellent tracking and particle identification. Charged pions, kaons and (anti-)protons are identified using the TPC specific energy loss ($\mathrm{d}E/\mathrm{d}x$) in the momentum range up to about 40 GeV/c. In this talk we present novel measurements of hadron composition (π/K/p) of charged jets from pp collisions at $\sqrt{\mathrm{s}}$ = 7 TeV. The results are compared to model calculations and the implications for identified hadron fragmentation functions are discussed.

Primary author(s) : LU, Xianguo (Ruprecht-Karls-Universitaet Heidelberg (DE))

Presenter(s) : LU, Xianguo (Ruprecht-Karls-Universitaet Heidelberg (DE))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **419** Type : **Contributed Talk**

Energy loss and (de)coherence effects beyond eikonal approximation

Monday, 19 May 2014 17:50 (0:20)

On behalf of collaboration:

None

Abstract content

The parton branching process is known to be modified in the presence of a medium. Colour decoherence processes are known to determine the process of energy loss when the density of the medium is large enough to break the correlations between partons emitted from the same parent. In order to improve existing calculations that consider eikonal trajectories for both the emitter and the hardest emitted parton, we provide in this work, the calculation of all finite energy corrections for the gluon radiation off a quark in a QCD medium that exist in the small angle approximation and for static scattering centres. Using the path integral formalism, all particles are allowed to undergo Brownian motion in the transverse plane and the offspring allowed to carry an arbitrary fraction of the initial energy. The result is a general expression that contains both coherence and decoherence regimes that are controlled by the density of the medium and by the amount of broadening that each parton acquires independently.

Primary author(s) : ARMESTO PEREZ, Nestor (Universidade de Santiago de Compostela (ES)); SALGADO LOPEZ, Carlos Albert (Universidade de Santiago de Compostela (ES)); TEIXEIRA DE ALMEIDA MILHANO, Guilherme (Instituto Superior Tecnico (PT)); APOLINARIO, Liliana (Universidade de Santiago de Compostela (ES))

Presenter(s) : APOLINARIO, Liliana (Universidade de Santiago de Compostela (ES))

Session Classification : Heavy flavor

Track Classification : New Theoretical Developments

Contribution ID : **425** Type : **Contributed Talk**

Higher harmonics from intrinsic multi-particle production

Monday, 19 May 2014 11:20 (0:20)

On behalf of collaboration:

None

Abstract content

We explore the detailed structure of the {\em ridge} in the Color-Glass-Condensate (CGC) effective field theory of QCD and demonstrate a novel mechanism that produces a non-vanishing v_3 without final-state re-scattering. A v_3 in agreement with the LHC p+Pb data is generated by the interference of diagrams attributed to the jet (away-side) and ridge (near-side) substructure of the azimuthal correlation. We also find that the v_3 in p+A is comparable to that in A+A for similar multiplicities.

Primary author(s) : DUSLING, Kevin

Co-author(s) : VENUGOPALAN, Raju (Brookhaven National Laboratory)

Presenter(s) : DUSLING, Kevin

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **427** Type : **Contributed Talk**

Production of strange particles in charged jets and underlying event in p–Pb and Pb–Pb collisions with ALICE

Tuesday, 20 May 2014 15:20 (0:20)

On behalf of collaboration:

ALICE

Abstract content

Properties of the hot and dense strongly interacting matter created in ultra-relativistic heavy-ion collisions can be studied using jets. Hadronization processes occurring in jets are expected to be modified by the interaction of partons with the medium.
At intermediate p_{T}, a strong increase of the baryon/meson ratio is observed for inclusive light particles produced in heavy-ion collisions when compared to the ratio measured in proton-proton collisions. Production by fragmentation cannot explain this phenomenon and other hadronization mechanisms, like coalescence or parton recombination, have been proposed instead. Measurements of spectra of identified particles produced in jets in heavy-ion collisions will provide further important insights into the interplay of hadronization processes which participate in the jet fragmentation in a medium dominated by the strong interaction under high temperatures and high energy densities.
In this talk, we present the first measurements of the p_{T} spectra of Λ and $\overline{\Lambda}$ baryons and $\mathrm{K}^0_{\mathrm{s}}$ mesons produced in association with charged jets in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV and p-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV measured by ALICE at the LHC, exploiting the excellent particle identification capabilities of this experiment. Baryon/meson ratios of the spectra of strange particles associated with jets are studied as a function of centrality and are compared to the ratios obtained for inclusive particles and for particles coming from the underlying event

Primary author(s) : ZHANG, Xiaoming (Lawrence Berkeley National Lab. (US))

Presenter(s) : ZHANG, Xiaoming (Lawrence Berkeley National Lab. (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **436** Type : **Contributed Talk**

Open charmed hadron production in p+p, Au+Au and U+U collisions at STAR

Monday, 19 May 2014 12:00 (0:20)

On behalf of collaboration:

STAR

Abstract content

Heavy quarks are dominantly produced from initial hard scatterings in high-energy heavy ion collisions, and their interaction with QCD medium is sensitive to the medium dynamics. Thus heavy quarks are suggested as excellent probes to study the properties of the hot and dense nuclear matter created at the Relativistic Heavy Ion Collider. In this talk, we present the first results of open charm meson production in U+U collisions at $\sqrt{s_{NN}}$=193 GeV from the STAR experiment. We also report on updated results in Au+Au collisions at $\sqrt{s_{NN}}$=200 GeV, and those in p+p collisions at $\sqrt{s}$=200 GeV and 500 GeV. In these measurements, D^0 and D^* mesons are reconstructed through hadronic decay channels. For both U+U and Au+Au collisions, invariant D^0 meson production yields are determined from minbias and 0-10% central triggered events for the p_T range from 0 to 6 GeV/c. For p+p collisions, events with high E_T triggers are used to extend the p_T range of the measured cross section up to 10 GeV/c at $\sqrt{s}$=200 GeV and to 18 GeV/c at $\sqrt{s}$=500 GeV, respectively. Nuclear modification factors (R_{AA}) of open charm mesons are extracted from these results and are compared to various theoretical model calculations.

Primary author(s) : Prof. YE, Zhenyu (University of Illinois at Chicago)

Presenter(s) : Prof. YE, Zhenyu (University of Illinois at Chicago)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **439** Type : **Contributed Talk**

Simulating full QCD at nonzero density using the complex Langevin equation

Tuesday, 20 May 2014 12:10 (0:20)

On behalf of collaboration:

None

Abstract content

The complex Langevin method is extended to full QCD at non-zero chemical potential. The method evades the sign problem which makes naive simulations at nonzero density impossible. The procedure 'gauge cooling' is used to stabilize the simulations at small enough lattice spacings. The method allows simulations also at high densities, all the way up to saturation. The method is validated in the small chemical potential region, where the sign problem is mild, and the reweighting approach is also feasible.

Primary author(s) : SEXTY, Denes (University of Heidelberg)

Presenter(s) : SEXTY, Denes (University of Heidelberg)

Session Classification : QCD at high temperature and/or density

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **440** Type : **Contributed Talk**

Studies of dijet and photon-jet properties in pp, pPb and PbPb collisions with CMS

Wednesday, 21 May 2014 10:20 (0:20)

On behalf of collaboration:

CMS

Abstract content

Studies of dijet and photon-jet properties in pPb collisions are of great importance to establish a QCD baseline for hadronic interactions with cold nuclear matter. Dijet and photon-jet production have been measured in pPb collisions at a nucleon-nucleon center-of-mass energy of 5.02 TeV. The transverse momentum balance and azimuthal angle correlations are studied in both dijet and photon-jet channels, leading to the observation that there is no significant modification, which allows these systems to be used as tools to probe the nuclear modifications of the parton distribution functions (PDFs). In the dijet system, pseudorapidity distributions are studied as a function of the transverse energy in the forward calorimeters ($\mathrm{E_T}^{HF}$). The mean value of the dijet pseudorapidity is found to change monotonically with increasing $\mathrm{E_T}^{HF}$, indicating a correlation between the energy emitted at large pseudorapidity and the longitudinal motion of the dijet frame. The pseudorapidity distribution of the dijet system is compared with next-to-leading-order perturbative QCD predictions obtained from both nucleon and nuclear PDFs, and the data more closely match the latter. In addition to the studies of initial state, the photon-jet measurements related to quenching in PbPb are updated to have a more precise pp reference based on the 2013 LHC run at 2.76 TeV.

Primary author(s) : BARBIERI, Richard Alexander (Massachusetts Inst. of Technology (US))

Presenter(s) : BARBIERI, Richard Alexander (Massachusetts Inst. of Technology (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **442** Type : **Contributed Talk**

Measurement of rare probes with the Silicon Tracking System of the CBM experiment at FAIR

Wednesday, 21 May 2014 11:30 (0:20)

On behalf of collaboration:

CBM

Abstract content

The Compressed Baryonic Matter experiment at FAIR will explore the phase diagram of strongly interacting matter at highest net baryon densities and moderate temperatures. The CBM physics program will be started with beams delivered by the SIS 100 synchrotron, providing energies from 2 to 11 GeV/nucleon for heavy nuclei, up to 14 GeV/nucleon for light nuclei, and 29 GeV for protons. The highest net baryon densities will be explored with ion beams up to 45 GeV/nucleon energy delivered by SIS 300 in the next stage of FAIR. Collision rates up to 10^7 per second are required to produce very rare probes with unprecedented statistics in this energy range. Their signatures are complex. These conditions call for detector systems designed to meet the extreme requirements in terms of rate capability, momentum and spatial resolution, and a novel DAQ and trigger concept which is not limited by latency but by throughput. In the presentation we describe the concepts of CBM's central detector, the Silicon Tracking System, and of the First-Level Event Selector, a dedicated computing farm to reduce on-line the raw data volume by up to three orders of magnitude to a recordable rate. Progress with the development of detector and software algorithms are discussed and examples of performance studies on the reconstruction of rare probes at SIS 100 and SIS 300 energies given.

Primary author(s) : Dr. FRIESE, Volker (GSI); Dr. HEUSER, Johann (GSI)

Presenter(s) : Dr. HEUSER, Johann (GSI)

Session Classification : Future experimental facilities, upgrades, and instrumentation

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **443** Type : **Contributed Talk**

Jet and charged hadron nuclear modification factors in pPb and PbPb collisions with CMS

Tuesday, 20 May 2014 09:20 (0:20)

On behalf of collaboration:

CMS

Abstract content

One of the signatures of the strongly interacting medium produced in central PbPb collisions is the suppression of high-p_{T} jets and charged particles. In order to to disentangle the initial state and final state effects in heavy ion collisions, the nuclear modification factor of both jets and of charged-particles in pPb (R_{pPb}) and PbPb (R_{PbPb}) collisions are presented. The spectra of both jets and charged-particles in pp collisions at $\sqrt{s} = 2.76$, PbPb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, and pPb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, have been measured with the CMS detector using high statistics samples. The R_{pPb} of charged particles is determined by dividing the measured pPb spectrum by a pp reference spectrum constructed using interpolation methods, or alternatively from PYTHIA simulations.

Primary author(s) : APPELT, Eric Andrew (Vanderbilt University (US))

Presenter(s) : APPELT, Eric Andrew (Vanderbilt University (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **444** Type : **Contributed Talk**

b-jet tagged nuclear modification factors in heavy ion collisions with CMS

Wednesday, 21 May 2014 11:10 (0:20)

On behalf of collaboration:

CMS

Abstract content

The energy loss of jets in heavy-ion collisions is expected to depend on the flavor of the fragmenting parton. Thus, measurements of jet quenching as a function of flavor place powerful constraints on the thermodynamical and transport properties of the hot and dense medium. Measurements of the nuclear modification factors of the heavy-flavor-tagged jets in both PbPb and pPb collisions can quantify such energy loss effects. Specifically, pPb measurements provide crucial insights into the behavior of the cold nuclear matter effect, which is required to fully understand the hot and dense medium effects on jets in PbPb collisions. In this talk, we present the b-jet spectra and the first measurement of the nuclear modification factors as a function of transverse momentum and pseudorapidity, using the high statistics pp, pPb and PbPb data taken in 2011 and 2013.

Primary author(s) : JUNG, Kurt Eduard (Purdue University (US))

Presenter(s) : JUNG, Kurt Eduard (Purdue University (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **445** Type : **Contributed Talk**

Jet-track correlation in PbPb collisions with CMS

Wednesday, 21 May 2014 09:00 (0:20)

On behalf of collaboration:

CMS

Abstract content

A strong modification of jet properties has been observed in central PbPb collisions when compared to the results from pp collisions. To characterize the energy flow, we present the first detailed measurement of the energy flow of quenched jets with the CMS detector. Those new results extend previous measurements to large angle with respect to the quenched jets, using the high statistics pp and PbPb data taken in 2011-13. Jet shapes, fragmentation functions and missing transverse momenta are studied by correlating jets and tracks as a function of centrality and dijet asymmetry.

Primary author(s) : GULHAN, Doga Can (Massachusetts Inst. of Technology (US))

Presenter(s) : GULHAN, Doga Can (Massachusetts Inst. of Technology (US))

Session Classification : Jets

Track Classification : Jets

Contribution ID : **448** Type : **Contributed Talk**

Bottomonia in pp, pPb and PbPb with CMS

Wednesday, 21 May 2014 09:40 (0:20)

On behalf of collaboration:

CMS

Abstract content

Bottomonia are important probes of the quark-gluon plasma since they are produced at early times and propagate through the medium, mapping its evolution. The three Y states (1S, 2S, 3S) were measured separately using the Compact Muon Solenoid (CMS) experimental apparatus and observed to disappear sequentially in PbPb collisions at 2.76 TeV. However, recent measurements in pp and pPb collisions, at 2.76 and 5.02 TeV respectively, show a surprising dependence of the excited (2S or 3S) over the ground (1S) state ratio, as a function of the global event activity. The three states are also observed to be individually more produced in events with more activity, for the three collision systems. In this talk, we will review the latest results from pp, pPb and PbPb collisions and highlight their possible interpretations.

Primary author(s) : VALIYAVALAPPIL KIZHAKKEPURA, Abdulla Abdulsalam (Bhabha Atomic Research Centre (IN))

Presenter(s) : VALIYAVALAPPIL KIZHAKKEPURA, Abdulla Abdulsalam (Bhabha Atomic Research Centre (IN))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **450** Type : **Contributed Talk**

Charmonia in pp, pPb and PbPb with CMS

Tuesday, 20 May 2014 09:00 (0:20)

On behalf of collaboration:

CMS

Abstract content

The mechanisms through which charmonia production is modified in the high-density medium created in ultra-relativistic heavy-ion collisions, are still not quantitatively understood. In order to disentangle among different scenarios, a multi-dimensional analysis in a wide kinematic range is needed, in pp, pA and AA collisions, looking at many observables that have different sensitivities to the various aspects of charmonia production. We will report on the prompt J/ψ measurements with the CMS detector, using the 35 nb^{-1} pPb data recorded in 2013 and the 150 $\mu\mathrm{b}^{-1}$ of PbPb data recorded in 2011. The nuclear modification factors and azimuthal anisotropy in PbPb collisions at 2.76 TeV will be presented. New measurements of the forward to backward ratios in pPb collisions at 5.02 TeV will also be shown. The dependence of all these observables on the prompt J/ψ kinematics, as well as the event characteristics, will be shown. In addition, the comparison of the excited charmonium state ($\psi(2S)$) and the ground state (J/ψ) between PbPb and pp is updated, utilizing the pp sample from 2013, which has a factor of 20 higher statistical precision than the 2011 pp data previously presented.

Primary author(s) : MOON, Dong Ho (University of Illinois at Chicago (US))

Presenter(s) : MOON, Dong Ho (University of Illinois at Chicago (US))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **457** Type : **Contributed Talk**

Bose-Einstein correlation measurements at CMS

Wednesday, 21 May 2014 11:10 (0:20)

On behalf of collaboration:

CMS

Abstract content

Multidimensional and one-dimensional quantum-statistical (Bose-Einstein) correlations are measured in proton-proton collisions at 0.9, 2.76 and 7 TeV, and in proton-lead collisions at 5.02 TeV/nucleon pair center-of-mass energy with the CMS detector at the LHC. The correlation functions are extracted in terms of different components of the relative momentum of the pair, in order to investigate the extension of the emission source in different directions. The results are presented for different intervals of transverse pair momentum, k_T, and charged particle multiplicity of the collision, N_{ch}, as well as for their integrated values. Besides inclusive charged particles, charged pions and kaons, identified via their energy loss in the silicon tracker detector, can also be correlated. The extracted source radii are reaching the highest values for very high multiplicity pPb collisions, and decrease with increasing k_T. The results open the possibility to study scaling and factorization properties of these radii as a function of multiplicity, k_T, colliding system size and center-of-mass energy.

Primary author(s) : DOGRA, Sunil Manohar (UNESP - Universidade Estadual Paulista (BR))

Presenter(s) : DOGRA, Sunil Manohar (UNESP - Universidade Estadual Paulista (BR))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **468** Type : **Contributed Talk**

Femtoscopic pair correlations of mesons and baryons at RHIC and LHC from hydrokinetic model

Wednesday, 21 May 2014 11:50 (0:20)

On behalf of collaboration:

None

Abstract content

The femtoscopic scales for identical pions and kaons are presented at different centralities for the top energy RHIC and LHC A+A collisions in comparison with ones for p+p collisions. The later results are obtained in hydrokinetic model (HKM) in view of the quantum uncertainty principle. The three-dimensional pion and kaon emission source functions are extracted from the HKM model simulations for A+A collisions. The model describes well the experimental data, previously obtained by the PHENIX and STAR collaborations using the imaging technique. In particular, the HKM reproduces the non-Gaussian heavy tails of the source function in the pair transverse momentum (out) and beam (long) directions, observed in the pion case and practically absent for kaons. The role of the rescatterings and long-lived resonances decays in forming of the long range tails is investigated. The prediction is made for the source functions in the LHC Pb+Pb collisions at $\sqrt{s}$= 2.76 TeV. As for the baryon-baryon correlations, the source functions of pp, pΛ and p [U+0305]Λ pairs are found in Au+Au collisions and used by means of FSI correlation technique for an extraction of the scattering lengths in two-baryon systems. The role of residual correlations in formation of the total baryon-baryon correlation function is analyzed.
The talk is based on the results of the following works:

1. Iu.A. Karpenko, Yu.M. Sinyukov. Uniform description of bulk observables in the hydrokinetic model of A+A collisions at RHIC and LHC, Phys. Rev. C 87, 024914 (2013).
2. V.M. Shapoval, P. Braun-Munzinger, Iu.A. Karpenko, Yu.M. Sinyukov. Femtoscopic scales in p+p and p+Pb collisions in view of the uncertainty principle. Phys. Lett. B 725, 139 (2013).
3. V.M. Shapoval, Yu.M. Sinyukov, Iu.A. Karpenko. Emission source functions in heavy ion collisions, Phys. Rev C 88 064904 (2013).
4. V. M. Shapoval, B. Erazmus, R. Lednicky, and Yu. M. Sinyukov. Extracting pΛ and p [U+0305]Λ scattering lengths from heavy ion collisions. Proceedings of the International School-Seminar “New Physics and Quantum Chromodynamics at External Conditions”, pp. 115-119 , 2013, Dnipropetrovsk, Ukraine. (Publication in preparation).
5. V.M. Shapoval, P. Braun-Munzinger, Iu.A. Karpenko, Yu.M. Sinyukov. Femtoscopic correlations of kaons in Pb+Pb and p+p collisions at LHC within hydrokinetic model. (Publication in preparation).

Primary author(s) : Prof. SINYUKOV, Yuri (Bogolyubov Institute for Theoretical Physics)

Co-author(s) : Prof. BRAUN-MUNZINGER, Peter (EMMI/GSI); Mr. SHAPOVAL, Volodymyr (Bogolyubov Institute for Theoretical Physics); Prof. LEDNICKY, Richard (JINR)

Presenter(s) : Prof. SINYUKOV, Yuri (Bogolyubov Institute for Theoretical Physics)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **474** Type : **Contributed Talk**

Z and W production in pp, pPb and PbPb collisions with CMS

Monday, 19 May 2014 17:10 (0:20)

On behalf of collaboration:

CMS

Abstract content

The weak bosons, Z and W, do not participate in the strong interaction, and thus constitute clean probes of the initial state of nuclear collisions. Detected trough their leptonic decay channels, they provide constraints on the nuclear parton distribution functions (PDF). In particular the W boson proves a unique constraint on the sea quark distributions. We report on CMS measurements of weak boson production in pp, pPb and PbPb. Particular emphasis is place on measurements of the 35 nb^{-1} of pPb data collected at the beginning of 2013. This provides access to a Bjorken x region, 10^{-3} – 1, which is lacking precision experimental measurements needed by nuclear PDF parametrizations. The Z boson nuclear modification factors as a function of transverse momentum and rapidity will be shown, together with forward to backward ratios. The W boson yields, charge asymmetries, and forward to backward ratios in pPb collisions will also be reported. With a production cross section an order of magnitude larger than the Z, the W allows precise comparisons to theoretical predictions. Comparisons to PDFs are made for both Z and W measurements

Primary author(s) : ZSIGMOND, Anna (Wigner RCP, Budapest (HU))

Presenter(s) : ZSIGMOND, Anna (Wigner RCP, Budapest (HU))

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **480** Type : **Contributed Talk**

Heavy-ion physics studies for the Future Circular Collider

Wednesday, 21 May 2014 13:10 (0:20)

On behalf of collaboration:

None

Abstract content

A five-year international design study called Future Circular Collider (FCC) has been launched by CERN with a kick-off meeting in February 2014. The main goal is a hadron collider with a centre-of-mass energy of the order of 100 TeV for pp collisions in a new 80-100 km tunnel in the Geneva area. The target start of operation would be 2035-40.

Operating such machine with heavy ions is an option that is being considered in the accelerator design studies. It would provide, for example, Pb-Pb and p-Pb collisions at $\sqrt{s_{\rm NN}} = 39$ and 63 TeV, respectively, with monthly integrated luminosities of the order of 5-10/nb.

We will present first ideas on the physics opportunities with heavy ions at the FCC.

The Quark-Gluon Plasma (QGP) state produced in Pb-Pb collisions at 39˜TeV is expected to have initial temperature and energy density substantially larger than at LHC energy, a stronger flow field and freeze-out volume twice as large. The larger temperature could entail novel features, like changes in the quarkonium spectrum and abundant in-medium production of charm quarks. The latter could determine an increase in the number of degrees of freedom (from 3 to 4 quark flavours). The larger energy and luminosities will make new, rarer, hard probes available (like top quarks and $Z + Jets$), which could give access to the time-evolution of the medium properties, e.g. of its opacity.

In the sector of small-x and saturation physics, the increase in centre-of-mass energy of a factor seven with respect to the LHC will extend the kinematic coverage in x and Q^2, providing, with pA and γA (ultra-peripheral collisions), access to the saturation region down to $x < 10^{-6}$ with perturbative probes like heavy quarks and quarkonia.

High-density or collective effects in high-multiplicity pp and pA events could become more dramatic, with the increase of energy and high-multiplicity reach.

Opportunities for electroweak physics studies in UPC gamma-gamma collisions, as well as the impact of heavy-ion data at the FCC for ultra-high energy cosmic-ray physics, will also be summarized.

Primary author(s) : DAINESE, Andrea (INFN - Padova (IT))

Co-author(s) : ARMESTO PEREZ, Nestor (Universidade de Santiago de Compostela (ES)); D'ENTERRIA, David (CERN); Dr. MASCIOCCHI, Silvia (GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE)); Dr. ROLAND, Christof (Massachusetts Inst. of Technology (US)); SALGADO LOPEZ, Carlos Albert (Universidade de Santiago de Compostela (ES)); VAN LEEUWEN, Marco (University of Utrecht (NL)); WIEDEMANN, Urs (CERN)

Presenter(s) : DAINESE, Andrea (INFN - Padova (IT))

Session Classification : Future experimental facilities, upgrades, and instrumentation

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **493** Type : **Contributed Talk**

Elliptic flow and nuclear modification factor within a partonic transport model

Monday, 19 May 2014 17:30 (0:20)

On behalf of collaboration:

None

Abstract content

An updated version of the partonic transport model Boltzmann Approach to Multi-Parton Scatterings (BAMPS) is presented, which numerically solves the 3+1D Boltzmann equation by allowing interactions among all parton species: gluons, light quarks, and heavy quarks with both elastic and inelastic collisions. We introduce the improved Gunion-Bertsch matrix element, which cures problems of the original Gunion-Bertsch result in characteristic regions of the phase space. Based on extensive numerical calculations, the improved matrix element agrees well with the exact pQCD calculation. While employing the new matrix element, important properties of the quark-gluon plasma created in heavy-ion collisions such as the thermalization time of the plasma and the shear viscosity over entropy density ratio are calculated within the microscopic transport model BAMPS. Furthermore, we compare our results of the nuclear modification factor and elliptic flow to experimental data measured at RHIC and LHC.

Primary author(s) : Prof. GREINER, Carsten (University of Frankfurt)

Co-author(s) : WESP, Christian (Goethe Universität Frankfurt); Prof. XU, Zhe (Tsinghua University Beijing); UPHOFF, Jan (Goethe University Frankfurt); Dr. FOCHLER, Oliver (Goethe-Universität Frankfurt); SENZEL, Florian (Goethe-Universität Frankfurt)

Presenter(s) : Prof. GREINER, Carsten (University of Frankfurt)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **495** Type : **Contributed Talk**

Why is the radial flow in high multiplicity pp/pA stronger than in AA?

Monday, 19 May 2014 12:40 (0:20)

On behalf of collaboration:

None

Abstract content

With growing multiplicity, the pp and pA collisions enter the domain where the macroscopic description (thermodynamics and hydrodynamics) becomes applicable. We discuss this situation, first with simplified thought experiments, then with some idealized representative cases, and finally address the real data. For clarity, we don't do it numerically but analytically, using the Gubser solution. We found that the radial flow is expected to increase from central AA to central pA. Recent CMS and ALICE data confirm that it is the case. We discuss the consequences of these finding.

Primary author(s) : SHURYAK, Edward (stony brook university)

Presenter(s) : SHURYAK, Edward (stony brook university)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **503** Type : **Contributed Talk**

Studies of two-particle correlations with identified π^0, K^0_s and Lambdas in pPb and PbPb collisions with CMS

Tuesday, 20 May 2014 15:40 (0:20)

On behalf of collaboration:

CMS

Abstract content

Observation of a long-range near-side two-particle correlation (known as the “Ridge") in high-multiplicity pp and pPb collisions opened up new opportunities of exploring novel QCD dynamics in small collision systems. To further investigate the origin of this phenomenon, new measurements of two-particle correlations with identified π^0, K^0_s and Lambda trigger particles in 5.02 TeV pPb and 2.76 TeV PbPb collisions are presented. One unique feature of this analysis is the implementation of a high-multiplicity trigger during the 2013 LHC pPb run, which enables the correlation studies to be performed up to a multiplicity range that is comparable to mid-central PbPb collisions at 2.76 TeV. The K^0_s and Lambdas are cleanly reconstructed via their secondary decay vertices over a wide pseudorapidity and transverse momentum range $0.2 < p_T < 6$ GeV/c. Neutral pions are reconstructed through the decay channel of two photons in the p_T range of 0.7-5.0 GeV/c. The second-order (v_2) and third-order (v_3) anisotropy harmonics of π^0, K^0_s and Lambda are extracted from long-range correlations as a function of particle multiplicity and p_T. The wide p_T coverage and rich sample of high multiplicity pPb events allow: (1) a precise examination of the mass ordering effect of v_n at low p_T as predicted by hydrodynamics for a collectively expanding medium; (2) exploration of possible constituent quark number scaling of v_2 and v_3 between mesons and baryons as was observed in high-energy nucleus-nucleus collisions.

Primary author(s) : SHARMA, Monika (Vanderbilt University (US))

Presenter(s) : SHARMA, Monika (Vanderbilt University (US))

Session Classification : Correlations and fluctuations

Track Classification : Collective Dynamics

Contribution ID : **504** Type : **Contributed Talk**

Azimuthal anisotropy of charged particles from multiparticle correlations in pPb and PbPb collisions with CMS

Tuesday, 20 May 2014 12:10 (0:20)

On behalf of collaboration:

CMS

Abstract content

Motivated by two- and four-particle azimuthal correlation measurements that suggest possible collective flow for charged particles emitted in pPb collisions at $\sqrt{s_{NN}}$ =5.02 TeV, we extend the correlation results for these collisions using the six- and eight-particle cumulant methods, and the Lee-Yang Zeros method. CMS has an extensive program studying azimuthal harmonic coefficients for both PbPb and pPb collisions using various methods. The current pPb results will be presented in this context. The data were collected by the CMS experiment at the LHC using both minimum bias and high-multiplicity collision triggers over a wide range in pseudorapidity. The results are compared to 2.76 TeV semi-peripheral PbPb collision data collected in 2011 covering a similar range of particle multiplicities. The second-order azimuthal anisotropy Fourier harmonic (v_2) is shown for the different methods. A comparison of the six- and greater particle correlations to the previously published two- and four-particle correlation results sheds light on the multiparticle nature of the azimuthal anisotropy. The results are also discussed in terms of recent calculations that explore the role of participant fluctuations on measurements of higher-order particle correlations in pPb collisions.

Primary author(s) : WANG, Quan (University of Kansas (US))

Presenter(s) : WANG, Quan (University of Kansas (US))

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **505** Type : **Contributed Talk**

Pseudorapidity dependence of near-side and away-side long-range correlations in pPb collisions with CMS

Tuesday, 20 May 2014 14:20 (0:20)

On behalf of collaboration:

CMS

Abstract content

Two-particle long-range pseudorapidity ($\Delta\eta$) correlations are observed in pPb collisions at the LHC. Previous correlation measurements have been averaged over both the trigger and associated particle η. In order to explore the possible pseudorapidity dependence of the long-range correlations in asymmetric pPb collisions, a new analysis of two-particle correlations with trigger particles at various fixed eta locations is presented. The data were collected during the 2013 LHC pPb run at a nucleon-nucleon center-of-mass energy of 5.02 TeV by the CMS experiment, with a wide eta coverage of -2.4$<\eta<$2.4. The near-side $\Delta\eta$ correlations are decomposed into short-range (jet) and long-range components. The away-side long-range correlations in central collisions are also studied by subtracting back-to-back jet contributions, modeled by the away-side correlations from peripheral collisions after accounting for the biases introduced by the multiplicity classification. The long-range correlations are found to be dependent on pseudorapidity. The observed pseudo-rapidity dependence may potentially discriminate theoretical models for long-range two-particle correlations observed in pPb collisions.

Primary author(s) : XU, Lingshan (Purdue University (US))

Presenter(s) : XU, Lingshan (Purdue University (US))

Session Classification : Correlations and fluctuations

Track Classification : Collective Dynamics

Contribution ID : **506** Type : **Contributed Talk**

Vector screening masses in the quark-gluon plasma and their physical significance

Tuesday, 20 May 2014 12:30 (0:20)

On behalf of collaboration:

None

Abstract content

Static and non-static thermal screening states that couple to the conserved vector current are investigated in the high-temperature phase of QCD. Their masses and couplings to the current are determined at weak coupling, as well as using two-flavor lattice QCD simulations. A consistent picture emerges from the comparison, providing evidence that non-static Matsubara modes can indeed be treated perturbatively. We elaborate on the physical significance of the screening masses.

Primary author(s) : Prof. MEYER, Harvey B. (Joh. Gutenberg University Mainz); Prof. LAINE, Mikko (Bern University); Dr. FRANCIS, Anthony (Helmholtz Institute Mainz); Dr. BRANDT, Bastian B. (Regensburg University)

Presenter(s) : Prof. MEYER, Harvey B. (Joh. Gutenberg University Mainz)

Session Classification : QCD at high temperature and/or density

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **507** Type : **Contributed Talk**

Factorization breakdown of two-particle correlations and flow phenomena in pPb and PbPb collisions with CMS

Tuesday, 20 May 2014 09:20 (0:20)

On behalf of collaboration:

CMS

Abstract content

The technique of two-particle correlations has been widely used in studying flow via azimuthal anisotropy in relativistic heavy-ion collisions. A key assumption imposed in this approach is the factorization of Fourier coefficients extracted from two-particle correlations into a product of single-particle anisotropies of trigger and associated particles. It was recently predicted by hydrodynamics that due to initial-state participant fluctuations, a transverse momentum (p_T) dependence of the event-plane angle would be induced, leading to a breakdown of factorization, even if hydrodynamic flow is the only source of correlations. We present a systematic examination of the factorization assumption in 5.02 TeV pPb and 2.76 TeV PbPb collisions with the CMS experiment. Significant breakdown of factorization (up to 20%) is observed in a large sample of ultra-central (0–0.2%) triggered PbPb events, where initial-state fluctuations play a dominant role. Comparison of data and viscous hydrodynamics predictions, as a function of p_T and centrality, allows new constraints on the modeling of initial condition and shear viscosity to entropy density (η/s) ratio of the medium created in heavy-ion collisions. Furthermore, the measurement is also extended to high-multiplicity pPb collisions. As the initial-state geometry of a pPb collision is expected to be entirely a consequence of fluctuations, quantitative studies of factorization breakdown will help to investigate the nature of the observed long-range correlations in pPb collisions, particularly in the context of hydrodynamic models.

Primary author(s) : DEVETAK, Damir (University of Belgrade (RS))

Presenter(s) : DEVETAK, Damir (University of Belgrade (RS))

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **509** Type : **Contributed Talk**

Open beauty measurements in pPb collisions with CMS

Monday, 19 May 2014 15:40 (0:20)

On behalf of collaboration:

CMS

Abstract content

We report the first measurements of fully reconstructed B mesons in collisions involving heavy ions. Rapidity and transverse momentum cross sections, measured at $\sqrt{s_{NN}} = 5.02$ TeV with the CMS detector, will be presented. For the same collision system, we will also report on the production of inclusive b-hadrons identified via their decays into J/ψ displaced from the primary collision vertex, and measured in a similar kinematic range as the identified B mesons. The nuclear modification factors, which are constructed using a theoretically calculated pp reference, will be shown together with cross-section asymmetries between equivalent positive and negative pseudo-rapidity ranges in the center-of-mass frame of the collision.

Primary author(s) : KIM, Hyunchul (Korea University (KR))

Presenter(s) : KIM, Hyunchul (Korea University (KR))

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **514** Type : **Contributed Talk**

Causal baryon diffusion and colored noise

Wednesday, 21 May 2014 09:40 (0:20)

On behalf of collaboration:

None

Abstract content

We construct a model of baryon diffusion which has the desired properties of causality and analyticity. The model also has the desired property of colored noise, meaning that the noise correlation function is not a Dirac delta function in space and time; rather, it depends on multiple time and length constants. The model can readily be incorporated in 3+1 dimensional 2nd order viscous hydro-dynamical models of heavy ion collisions, which is particularly important at beam energies where the baryon density is large.

Primary author(s) : Prof. KAPUSTA, Joseph (University of Minnesota)

Co-author(s) : Dr. YOUNG, Clint (University of Minnesota)

Presenter(s) : Prof. KAPUSTA, Joseph (University of Minnesota)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **517** Type : **Contributed Talk**

Reviewing hadron production in the SIS energy regime using new HADES Au+Au data

Tuesday, 20 May 2014 15:20 (0:20)

On behalf of collaboration:

HADES

Abstract content

Data on particle production in heavy ion collisions in the energy regime of 1-2 A GeV have been collected over almost three decades now. As most of the newly created hadrons are produced below or slightly above their free NN-thresholds, data are usually interpreted with the help of phenomenological models, rather than comparing to elementary reference measurements. Driven by advance in detector technology, more and more rare and penetrating probes have become accessible, and still keep challenging our knowledge about the properties of the created system and its dynamical evolution. The recently collected HADES data from Au+Au collisions at 1.23 A GeV represents in this energy regime the most advanced sample of heavy ion collisions in terms of precision and statistics (7*10^9 collected events). Using the yields and spectra of reconstructed hadrons ($\pi^{+-}, K^{+-}, K^0_s, \Lambda$) provides therefore the optimal bases to test state of the art models and to question the extent of our present understanding of hadron production. This work has been supported by BMBF (05P12RFGHJ), Helmholtz Alliance EMMI, HIC for FAIR, HGS-HIRe.

Primary author(s) : Dr. LORENZ, Manuel (GU Frankfurt)

Presenter(s) : Dr. LORENZ, Manuel (GU Frankfurt)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **535** Type : **Contributed Talk**

Critical enhancement of thermal photons

Monday, 19 May 2014 15:20 (0:20)

On behalf of collaboration:

None

Abstract content

A relatively small spectral slope and large elliptic flow of direct photons measured at RHIC and LHC has reignited the discussion of thermal photons as a probe of the quark-gluon plasma (QGP). We present a systematic discussion of the macro- and micro-physics that figures into calculating thermal emission spectra. For the bulk medium we compare the temperature and flow evolution in fireball [1] and hydrodynamic approaches [2], and study how different tunes of initial conditions, compatible with bulk hadron observables, affect the photon spectra. We deduce evidence for an enhancement of currently available hadronic and QGP emission rates around Tc, and a potential suppression of early QGP radiation (indicative for a gluon-rich early QGP). We then present an updated (more complete) assessment of hadronic emission channels involving meson exchange reactions in baryon-meson scattering which have not been considered thus far [3]. We also investigate consequences for thermal dilepton v2.
[1] H. van Hees, C. Gale and R. Rapp, Phys. Rev. C 84 (2011) 054906
[2] H. van Hees, M. He and R. Rapp, in preparation.
[3] N. Holt and R. Rapp, work in progress.

Primary author(s) : Prof. RAPP, Ralf (Texas A&M University)

Co-author(s) : VAN HEES, Hendrik (Goethe University Frankfurt); HE, Min (Nanjing University of Science and Technology)

Presenter(s) : Prof. RAPP, Ralf (Texas A&M University)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **540** Type : **Contributed Talk**

Direct virtual photon and dielectron production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV at STAR

Monday, 19 May 2014 14:40 (0:20)

On behalf of collaboration:

STAR

Abstract content

One important physics goal of ultra-relativistic heavy-ion collisions is to study the fundamental properties of a hot, dense medium created in these collisions. This medium is expected to emit thermal radiation which is in the form of direct photons and dileptons. Once produced, photons and leptons traverse the strongly interacting medium with minimal interactions. The fully installed Time-of-Flight Detector in 2010 enables clean electron identification from low to intermediate transverse momentum (p_T). In this talk, we will present the direct virtual photon production for $1<p_T<5$ GeV/c derived from the dielectron continuum in the dielectron invariant mass region $0.1<M_{ee}<0.3$ GeV/c^2 from one billion $\sqrt{s_{NN}}$ = 200 GeV Au+Au minimum bias events taken in 2010 and 2011. In addition, we will present the centrality and p_T dependence of dielectron production and the dielectron azimuthal angle correlation in the intermediate mass($1.1<M_{ee}<3$ GeV/c^2) region in this dataset. The relevant results from $\sqrt{s}$ = 200 GeV p+p collisions taken in 2012 will also be discussed. Comparisons to model calculations including hadronic and partonic thermal radiation will be made for both the direct virtual photon and dielectron production in Au+Au collisions.

Primary author(s) : YANG, Chi (USTC/BNL)

Presenter(s) : YANG, Chi (USTC/BNL)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **549** Type : **Contributed Talk**

What are multiplicity distributions telling us on QCD phase diagram?

Wednesday, 21 May 2014 12:50 (0:20)

On behalf of collaboration:

None

Abstract content

We report a new way to extract the QCD phase transition from the net baryon multiplicity. The method provides us not only a freeze-out temperature- density point, but also the neighbour of the point. In other words, Beam Energy Scan explores not only points, but also regions with the finite spreads in μ-T plane, where μ is the chemical potential, and T is the temperature.

First, we develop a formula in which canonical partition functions are constructed from multiplicities data for a conserved quantity. From the canonical partition functions, we construct the grand partition functions as a function of the fugacity, $\exp(\mu/T)$, from which we can investigate the system when it goes near to the QCD phase transition line. We discuss the applicability limit that comes from the maximum number of the multiplicity measured in experiments.

We extend the fugacity to the complex number region, and show the Lee-Yang zero structure, which allows us to see the statistical nature of the system. We calculate the Lee-Yang zero structure by the lattice QCD simulations, and find a very striking feature, i.e., the Roberge-Weiss transition at the deconfinement regions.

We investigate the net-proton multiplicity data at RHIC, although it is not a conserved quantity. Using the proposed method, we calculate the susceptibility and kurtosis as a function of μ/T for each T, and the Lee-Yang zeros, and compare them with those of the lattice QCD results.

Primary author(s) : NAKAMURA, Atsushi (Hiroshima Univ)

Co-author(s) : Dr. NAGATA, Keitaro (KEK)

Presenter(s) : NAKAMURA, Atsushi (Hiroshima Univ)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **552** Type : **Contributed Talk**

Searching for the "Ridge" in d+Au collisions at RHIC by STAR

Monday, 19 May 2014 17:30 (0:20)

On behalf of collaboration:

STAR

Abstract content

Long-range pseudo-rapidity ($\Delta\eta$) correlations at small azimuthal difference ($\Delta\phi$) are observed in high multiplicity p+p and p+Pb collisions at the LHC. Subtraction of the di-hadron correlation in low-multiplicity p+Pb collisions from high-multiplicity ones reveals a back-to-back double ridge structure ($\Delta\phi \approx 0$ and π). A similar double ridge is observed in high-multiplicity d+Au collisions by the PHENIX experiment in their limited acceptance. Differences between multiplicity-selected d+Au collisions (and p+p collisions) have been observed before by STAR. However, the question remains open whether the ridge in d+Au collisions is a jet-related difference between central and peripheral collisions, or a new physics phenomenon such as anisotropic flow in d+Au. STAR, with its large acceptance, can rigorously address this question.

In this talk, we report di-hadron $\Delta\eta$-$\Delta\phi$ correlations in d+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. At mid-rapidity (with $|\Delta\eta| < 2$), the jet-like correlation contribution in "central−peripheral" method is evaluated. At large $|\Delta\eta| \approx 3$, the comparison of di-hadron correlations in central and peripheral collisions is reported in terms of the Au and deuteron beam directions. The $\Delta\phi$ correlation functions are also analyzed via a Fourier series decomposition; the $|\Delta\eta|$ and multiplicity dependencies of the Fourier coefficients are investigated. These di-hadron correlations data over the large acceptance may elucidate the existence or lack of a ridge in d+Au collisions at RHIC.

Primary author(s) : YI, Li

Presenter(s) : YI, Li

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **554** Type : **Contributed Talk**

Semi-inclusive recoil jet distribution and di-jets imbalance measurements in central Au+Au collisions in STAR

Wednesday, 21 May 2014 09:40 (0:20)

On behalf of collaboration:

STAR

Abstract content

The measurement of fully reconstructed jets in heavy ion collisions provides unique probes of the Quark-Gluon Plasma (QGP). However, full jet reconstruction in such events is challenging due to a large population of combinatorial background "jets" that overwhelm the true hard jet population by several orders of magnitude. In order to carry out accurate, data-driven jet measurements over a broad kinematic range at RHIC energies, we developed a novel mixed-event technique that describes the combinatorial jet background over several orders of magnitude with high precision. We apply this technique to measure the semi-inclusive charged jet distribution recoiling from a high p_T hadron trigger in central Au+Au collisions at $\sqrt{s_{NN}}$ =200 GeV. We report the recoil jet distribution for various trigger p_T ranges and jet radii, and study the azimuthal distribution between the recoil jet and trigger hadron. In addition we present the first measurement at RHIC of the di-jet transverse momentum asymmetry, A_J. Both measurements are performed with a very low infrared cutoff on jet constituents of 200 MeV. These jet coincidence measurements allow a direct comparison of jet quenching at RHIC and the LHC.

Primary author(s) : PUTSCHKE, Joern (Wayne State University)

Presenter(s) : PUTSCHKE, Joern (Wayne State University)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **557** Type : **Contributed Talk**

The STAR Heavy Flavor Tracker

Wednesday, 21 May 2014 11:50 (0:20)

On behalf of collaboration:

STAR

Abstract content

In relativistic heavy-ion collisions at RHIC, heavy quarks are primarily created from initial hard scatterings. Due to the heavy masses, their intrinsic properties are much less affected by the QCD medium compared to those of light quarks. Therefore heavy quark hadrons are suggested as a clean probe for the studying of early dynamic evolution of the dense and hot medium created in high-energy nuclear collisions. To enhance the study of heavy quark production at RHIC, the Heavy Flavor Tracker (HFT) for the STAR experiment has been built and installed before RHIC Run 14. The HFT consists of four layers of silicon detectors. The two outermost layers are silicon strip detectors and the two innermost layers are made from the state of art ultra thin CMOS Monolithic Active Pixel Sensors (MAPS). This is the first application of the CMOS MAPS detector in a collider experiment. The thin pixel sensors plus the carbon fiber supporting design reduces the material to 0.4 % radiation length per pixel detector layer, enabling reconstruction of low pT heavy flavor hadrons. In this talk, the status and performance of HFT in the current 200 GeV Au+Au run will be discussed.

Primary author(s) : Dr. QIU, Hao (LBNL)

Presenter(s) : Dr. QIU, Hao (LBNL)

Session Classification : Future experimental facilities, upgrades, and instrumentation

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **559** Type : **Contributed Talk**

Thermal photon v_3 at LHC from event-by-event hydrodynamics

Monday, 19 May 2014 12:00 (0:20)

On behalf of collaboration:

None

Abstract content

Thermal photon v_3 is calculated for 0–40% central collisions of Pb nuclei at LHC from event-by-event ideal hydrodynamic model [1]. The differential triangular flow parameter $v_3(p_T)$ calculated with respect to the participant plane (PP) is found to be non-zero, positive, and shows similar qualitative nature to the elliptic flow parameter $v_2(p_T)$ [2]. At $p_T = 1$ GeV v_3(PP) is found to be about half of v_2(PP) however, for larger values of p_T these two anisotropy parameters become comparable. The global geometry of the produced matter as well as the local fluctuations in the initial density distribution are responsible for this substantial value of the triangular flow parameter for thermal photons where v_3(PP) probes the initial state geometry in an indirect way via the generation of additional transverse flow. v_3 calculated with respect to the reaction plane as expected is close to zero. v_3(PP) strongly depends on the value of the fluctuation size parameter σ especially in the higher p_T region where, a larger σ results in a smaller v_3(PP). In addition, the v_3(PP) is found to increase with the initial formation time of the system.
[1] R. Chatterjee, D. K. Srivastava, and T. Renk, arXiv:1401.7464.
[2] R. Chatterjee, H. Holopainen, I. Helenius, T. Renk, and K. J. Eskola, PRC88, 034901 (2013).

Primary author(s) : CHATTERJEE, Rupa

Co-author(s) : SRIVASTAVA, Dinesh (Variable Energy Cyclotron Centre, Kolkata); RENK, Thorsten (University of Jyväskylä)

Presenter(s) : CHATTERJEE, Rupa

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **562** Type : **Contributed Talk**

The QCD equation of state

Tuesday, 20 May 2014 12:50 (0:20)

On behalf of collaboration:

[Other]

Abstract content

The quark-gluon plasma (QGP), the deconfined high-temperature phase of QCD, is currently under extensive investigation in heavy-ion collision experiments at RHIC and LHC. The transition from the hadronic, low-temperature phase to the QGP is a rapid crossover, manifested by a significant change in bulk thermodynamic quantities. A fundamental characteristic of QCD is the equation of state, which is also an essential ingredient of hydrodynamic modeling of heavy-ion collisions.

We report our final result for the 2+1 flavor QCD equation of state in the continuum limit. We calculate the pressure, energy density and other thermodynamic quantities in the experimentally relevant temperature range $140 - 400$ MeV. We use the highly improved staggered quark (HISQ) action with the Goldstone pion mass tuned to about 160 MeV in the continuum limit. To perform the continuum extrapolation we use lattices with temporal extent $N_\tau = 6$, 8, 10 and 12.

Primary author(s) : BAZAVOV, Alexei (University of Iowa)

Presenter(s) : BAZAVOV, Alexei (University of Iowa)

Session Classification : QCD at high temperature and/or density

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **567** Type : **Contributed Talk**

Flow measurements and selection of body-body and tip-tip enhanced samples in U+U collisions at STAR

Monday, 19 May 2014 12:00 (0:20)

On behalf of collaboration:

STAR

Abstract content

The azimuthal anisotropy of particle production is commonly used in high-energy nuclear collisions to study the early evolution of the expanding system. The prolate shape of uranium nuclei provides the possibility to study how the initial geometry of the nuclei affects the azimuthal distributions. It also provides a unique opportunity to understand the initial conditions for particle production at mid-rapidity in heavy ion collisions.
In this talk, the two- and four- particle cumulant, $v_2(v_22$ and $v_24)$, from U+U collisions at $\sqrt{s_{NN}}$ = 193 GeV and Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV for inclusive charged hadrons will be presented. The STAR Zero Degree Calorimeter is used to subdivide the 0-1% centrality bin into even finer centralities. Differences were observed between the multiplicity dependence of v_22 for most central Au+Au and U+U collisions. Data was compared with a Monte Carlo Glauber model and it was seen that this model cannot explain the multiplicity dependence of v_22 in central collisions. It has also been demonstrated that ZDC and multiplicity in combination provide a way to select body-body or tip-tip enhanced samples of central U+U collisions. We will also present preliminary v_1 and v_2 results for inclusive charged hadrons from Au+Au and U+U collisions, with the first-order event plane determining from spectator neutrons. This type of event plane represents the reaction plane instead of the participant plane as used in other methods, this analysis provides an alternative approach to examine the eccentricity-scaling to reveal the QGP properties.

Primary author(s) : WANG, Hui (Brookhaven National Lab)

Presenter(s) : WANG, Hui (Brookhaven National Lab)

Session Classification : Initial state physics

Track Classification : Initial State Physics

Contribution ID : **572** Type : **Contributed Talk**

$\Lambda(K^0_S)$-$h^\pm$ azimuthal correlations with respect to event plane and searches for chiral magnetic and vortical effects

Tuesday, 20 May 2014 09:20 (0:20)

On behalf of collaboration:

STAR

Abstract content

QCD allows for the formation of parity-odd domains inside the Quark-Gluon Plasma (QGP). The proposed Chiral Magnetic Effect (CME) will lead to charge separation with respect to the reaction plane. Previous measurements from RHIC and LHC using charge-dependent two-particle azimuthal correlations with respect to the reaction plane are consistent with the expectation of charge separation from CME. However, the magnitude of the background correlation has not been understood and there is no reliable experimental approach to separate the background from a CME signal.

$\Lambda(K^0_S)$-$h^\pm$ azimuthal correlations are expected to provide another estimate on the intrinsic background from particle correlations. In addition, theoretical calculations of the Chiral Vortical Effect (CVE) predict a difference in baryon versus anti-baryon azimuthal correlations with respect to the reaction plane. We will present the first measurements of $\Lambda(K^0_S)$-$h^\pm$ and Λ-proton azimuthal correlations with respect to the event plane from Au+Au collisions at 39˜GeV and 200˜GeV from STAR to investigate the CME and CVE predictions. The physics implications of our measurements will also be discussed.

Primary author(s) : ZHAO, Feng (University of California, Los Angeles)

Presenter(s) : ZHAO, Feng (University of California, Los Angeles)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **574** Type : **Contributed Talk**

Measurements of direct-photon-hadron correlations and direct-photon azimuthal anisotropy by STAR

Monday, 19 May 2014 16:30 (0:20)

On behalf of collaboration:

STAR

Abstract content

Many observations have indicated that the fragmentation functions in nucleus-nucleus collisions are softened compared to that in proton-proton collisions. Different theoretical models have been proposed in order to describe the observed phenomena. For a deeper insight into the underlying physics and better constraints for the extracted parameters of the medium formed in nucleus-nucleus collisions, a calibrated probe is needed. Direct photons act as such probes, providing experimental tools to explore energy loss of hard-scattered patrons. We report systematic studies of azimuthal correlations of charged hadrons with respect to a direct-photon trigger in p+p and Au+Au collisions, using new data collected in 2008, 2009, and 2011. The nuclear modification factor of coincidence rate, I_{AA}, will be shown. We also report direct-photon azimuthal anisotropy as a function of transverse momentum at mid-rapidity with event plane reconstructed from particles at forward rapidity in Au+Au collisions using the STAR detector at RHIC. We discuss the results in the scope of current theoretical models.

Primary author(s) : Dr. M. HAMED, Ahmed (University of Mississippi, Texas A&M University)

Presenter(s) : Dr. M. HAMED, Ahmed (University of Mississippi, Texas A&M University)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **579** Type : **Contributed Talk**

Elliptic flow of light nuclei and identified hadrons, their centrality and energy dependence in STAR

Monday, 19 May 2014 15:00 (0:20)

On behalf of collaboration:

STAR

Abstract content

A strongly interacting medium, namely Quark Gluon Plasma (QGP), is formed in high energy heavy ion collisions at RHIC. Elliptic flow (v_2), the second order Fourier coefficient of azimuthal distribution of the produced particles with respect to reaction plane, is used to investigate the properties of QGP. Light nuclei (d, $\bar{d}$, t, ^3He), produced in such collisions, are believed to be formed by coalescence of nucleons. By comparing v_2 of light nuclei with their constituents, we can understand the production mechanism of nuclei in heavy ion collisions. At top RHIC energies, identified hadron v_2 revealed many features like the number-of-constituent quark (NCQ) scaling and mass ordering. With the combined statistics, we can test the scaling behaviors for rare multi-strange particles (ϕ, Ξ and Ω). An energy dependent difference in v_2 (Δv_2) between particles and anti-particles was also observed in beam energy scan data at STAR.

In this talk, we show the p_T and centrality dependence of v_2 of light nuclei (d, $\bar{d}$, t, ^3He), and identified hadrons ($\pi^{\pm}$, $K^{\pm}$, K^0_s, p, $\bar{p}$, ϕ, Λ, $\bar{\Lambda}$, $\Xi^{\pm}$, $\Omega^{\pm}$) at mid-rapidity for Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 11.5, 19.6, 27, 39, 62.4 and 200 GeV from STAR. Light nuclei and hadrons are identified using the time projection chamber and time-of-flight detector systems of STAR. The mass number and constituent quark scaling of nuclei v_2 will be presented. Light nuclei v_2 will be compared to those from $p(\bar{p})$ and to a coalescence model calculation using the phase space distributions of produced nucleons in a transport model. The centrality dependence of Δv_2 for identified hadron will be shown and compared to model calculations. We further discuss NCQ scaling and mass ordering of multi-strange hadron v_2 at the top energy Au+Au collisions at RHIC.

Primary author(s) : HAQUE, Md. Rihan (V)

Presenter(s) : HAQUE, Md. Rihan (V)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **580** Type : **Contributed Talk**

Exploiting intrinsic triangular geometry in relativistic He3+Au collisions to disentangle medium properties

Monday, 19 May 2014 17:50 (0:20)

On behalf of collaboration:

None

Abstract content

Recent results in d+Au and p+Pb collisions at RHIC and the LHC provide evidence for collective expansion and flow of the created medium. We propose a control set of experiments to directly compare particle emission patterns from p+Au, d+Au, and He3+Au or t+Au collisions at the same sqrt(sNN). Using Monte Carlo Glauber we find that a He3 or triton projectile, with a realistic wavefunction description, induces a significant intrinsic triangular shape to the initial medium and that, even with viscous damping, this survives into a significant third order flow moment v3. By comparing systems with one, two, and three initial hot spots, one can disentangle the effects from the initial spatial distribution of the deposited energy and viscous damping. These are key tools to answering the question of how small a droplet of matter is necessary to form a quark-gluon plasma described by nearly inviscid hydrodynamics. We describe our results from (arXiv:1312.4565) as well as new calculations including coupling to a hadronic cascade afterburner and full particle identified flow patterns.

Primary author(s) : NAGLE, jamie (University of Colorado)

Co-author(s) : ROMATSCHKE, Paul (U)

Presenter(s) : ROMATSCHKE, Paul (U)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **588** Type : **Contributed Talk**

Thermalization of over-occupied gluons

Tuesday, 20 May 2014 12:50 (0:20)

On behalf of collaboration:

[Other]

Abstract content

In the weak coupling limit, the color-glass condensate framework predicts that the initial conditions of heavy-ion collisions are characterized by intense gauge fields, or equivalently high occupation numbers of gluons. In my talk, I will describe how such initial conditions relax towards thermal equilibrium. In particular, I will discuss how such a system has dual descriptions in terms of either classical gauge field theory or effective kinetic theory of gluons. The domain of validity of the two descriptions is overlapping and I will numerically demonstrate the equivalence in the case of a non-expanding system.

Primary author(s) : KURKELA, Eero Aleksi (CERN); Mr. LU, Egang (McGill); Prof. MOORE, Guy (McGill); Mr. ABRAAO YORK, Mark (McGill)

Presenter(s) : KURKELA, Eero Aleksi (CERN)

Session Classification : New theoretical developments

Track Classification : New Theoretical Developments

Contribution ID : **593** Type : **Contributed Talk**

A perturbative approach to hydrodynamics

Tuesday, 20 May 2014 10:00 (0:20)

On behalf of collaboration:

None

Abstract content

Initial fluctuations in hydrodynamic fields such as energy density or flow velocity give access to understanding initial state and equilibration physics as well as thermodynamic and transport properties. We provide evidence that the fluid dynamic propagation of fluctuations of realistic size can be based on a background-fluctuation splitting and a systematic perturbative expansion in the fluctuating fields. Initial conditions are characterized by a Bessel-Fourier expansion for single events, event-by-event correlations and probability distributions. The evolution equations can be solved order-by-order in the expansion which allows to study the fluid dynamical propagation of single modes, the study of interaction effects between modes, the determination of the associated particle spectra and the generalization of the whole program to event-by-event correlations and distributions. We also show comparisons to flow measurements at the LHC.

Primary author(s) : FLOERCHINGER, Stefan (CERN)

Co-author(s) : WIEDEMANN, Urs (CERN); BERAUDO, Andrea (Universidade de Santiago de Compostela (ES)); DEL ZANNA, Luca (INFN Firenze); INGHIRAMI, Gabriele (INFN Firenze); ROLANDO, Valentina (University of Ferrara (Italy) and INFN (Ferrara))

Presenter(s) : FLOERCHINGER, Stefan (CERN)

Session Classification : Collective dynamics

Track Classification : Collective Dynamics

Contribution ID : **600** Type : **Contributed Talk**

Understanding the p/π ratio at LHC with an extended mass spectrum

Wednesday, 21 May 2014 10:00 (0:20)

On behalf of collaboration:

None

Abstract content

Recent measurements of the proton to pion ratio from ALICE at the LHC have found it to be lower than the expected ratio anticipated by thermal models. We investigated the role that Hagedorn states- massive resonances with an exponential mass spectrum and large decay widths- play in the determination of particle ratios at LHC through a scenario of multiparticle reactions and dynamical chemical equilibrium within the hadron gas phase. We show that it is possible to describe the lower p/π ratio at LHC while still obtaining the experimental ratio of K/π in the Hagedorn state scenario if the protons are underpopulated at the switching temperature from hydrodynamics to the hadron gas phase.

Primary author(s) : Dr. NORONHA-HOSTLER, Jacquelyn (University of Sao Paulo)

Co-author(s) : GREINER, Carsten (University of Frankfurt)

Presenter(s) : Dr. NORONHA-HOSTLER, Jacquelyn (University of Sao Paulo)

Session Classification : Thermodynamics and hadron chemistry

Track Classification : Thermodynamics and Hadron Chemistry

Contribution ID : **607** Type : **Contributed Talk**

AdS/CFT heavy-quark energy loss beyond the leading order

Monday, 19 May 2014 14:40 (0:20)

On behalf of collaboration:

None

Abstract content

We present new predictions for the suppression of heavy quark decay products at RHIC and LHC from a NLO AdS/CFT energy loss model. Previous predictions from a tomographic model based on only the leading order AdS/CFT contribution to energy loss and constrained by RHIC data disagreed with LHC D meson measurements. In this work we include for the first time a correct treatment of the momentum fluctuations induced in the heavy quark motion from the strongly-coupled thermal medium: we resolve the ambiguity in the evaluation of the stochastic Langevin equations using the Wong-Zakai theorem and properly take into account the fluctuations' deviations from the Einstein relations. The addition of the fluctuations leads to corrections to the suppression predictions, which are significant for charm quarks and their decay products. We demonstrate how further experimental measurements can provide insight into the dominant energy loss mechanisms in, and hence the physical properties of, the quark-gluon plasma produced in heavy ion collisions.

Primary author(s) : HOROWITZ, William (University of Cape Town)

Presenter(s) : HOROWITZ, William (University of Cape Town)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **611** Type : **Contributed Talk**

New approach to lattice QCD thermodynamics from Yang-Mills gradient flow

Tuesday, 20 May 2014 11:30 (0:20)

On behalf of collaboration:

None

Abstract content

A novel method to study the bulk thermodynamics in lattice gauge theory is proposed on the basis of the Yang-Mills gradient flow with a fictitious time t. The energy density (epsilon) and the pressure (P) of SU(3) gauge theory at fixed temperature are calculated directly on $32^3\times$ (6,8,10) lattices from the thermal average of the well-defined energy-momentum tensor ($T^R_{\mu\nu}(x)$) obtained by the gradient flow. It is demonstrated that the continuum limit can be taken in a controlled manner from the t-dependence of the flowed data.
[1] M. Asakawa, T. Hatsuda, E. Itou, M. Kitazawa and H. Suzuki [FlowQCD Coll.], arXiv:1312.7492 [hep-lat].

Primary author(s) : Dr. HATSUDA, Tetsuo (RIKEN)

Co-author(s) : Prof. ASAKAWA, Masayuki (Osaka Univ.); Dr. KITAZAWA, Masakiyo (Osaka Univ.); Prof. SUZUKI, Hiroshi (Kyushu Univ.); Dr. ITOU, Etsuko (KEK)

Presenter(s) : Dr. HATSUDA, Tetsuo (RIKEN)

Session Classification : New theoretical developments

Track Classification : New Theoretical Developments

Contribution ID : **612** Type : **Contributed Talk**

QGP properties from flow and correlations

Wednesday, 21 May 2014 12:50 (0:20)

On behalf of collaboration:

None

Abstract content

Recently the results of azimuthal HBT measurements with respect to the second and third order event plane are presented by PHENIX [1]. They extract ϵ_2 and ϵ_3 from the HBT radii which contain information about not only the source shape at freezeout but also the space-time evolution of QGP matter. They show the relation between initial $\epsilon_{2,3}$ which are obtained using a Glauber model and final $\epsilon_{2,3}$ which are extracted from the HBT radii. They find that the final ϵ_2 from the HBT radii is finite and smaller than the initial ϵ_2. On the other hand, the final ϵ_3 is vanishing, in spite of existence of finite initial ϵ_3. The interesting different response of ϵ_2 and ϵ_3 during space-time evolution gives us a clue to understand the detailed QGP properties.
For analyses of such high statistics experimental results, we develop a state of the art numerical scheme of causal viscous hydrodynamics for relativistic heavy ion collisions, which has a shock-wave capturing scheme and less numerical dissipation [2]. Furthermore, using the hydrodynamic algorithm, we construct a hybrid model of hydrodynamic model plus UrQMD to include the realistic freezeout processes. Using the model we investigate the time evolution of spatial anisotropies ϵ_n. We find that the sign of ϵ_3 changes from positive to negative during the space-time evolution, which suggests a solution of the vanishing final ϵ_3 from the HBT radii by PHENIX. From detailed analyses from flow and correlations, we discuss the initial conditions of hydrodynamic model and the detailed QGP properties such as transport coefficients.
[1] T. Niida for the PHENIX collaboration, Nucl. Phys. A 904-905C (2013) pp. 439-442 [arXiv:1304.2876]
[2] Y. Akamatsu, S. Inutsuka, C. Nonaka, M. Takamoto, J. Comp. Phys. (2014), pp. 34-54, [arXiv:1302.1665]

Primary author(s) : NONAKA, Chiho (Nagoya University)

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Presenter(s) : NONAKA, Chiho (Nagoya University)

Session Classification : Correlations and fluctuations

Track Classification : Collective Dynamics

Contribution ID : **623** Type : **Contributed Talk**

Quantifying jet modification as a function of energy lost and jet mass depletion

Tuesday, 20 May 2014 15:40 (0:20)

On behalf of collaboration:

None

Abstract content

Jet modification measurements to date are carried out by comparing a surviving jet, exiting a dense medium, with a vacuum (unmodified) jet at the same energy. We propose an extension to classify jet modification in heavy-ion collisions by also including the jet mass. The mass of a jet, as measured by jet reconstruction algorithms, is intimately connected to the jet's virtuality (or scale), which in turn has a considerable effect on such observables as the fragmentation function and jet shape observables. The leading hard parton, propagating through a dense medium tends to experience substantial virtuality (or mass) depletion along with energy loss, and thus accurate comparisons between surviving jets and jets produced in p-p collisions should take these effects into account. Using the event generator PYTHIA, we show the close relationship between the actual jet mass and that after applying a jet reconstruction algorithm. Using the in-medium event generator MATTER++, we demonstrate the clear difference between the mass of a surviving parton exiting a dense medium and a parton with a similar energy formed in a hard p-p event. Effects of this difference in jet mass on the ratio of fragmentation functions and jet shapes are also calculated.

Primary author(s) : MAJUMDER, Abhijit (Wayne state university)

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Presenter(s) : MAJUMDER, Abhijit (Wayne state university)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **624** Type : **Contributed Talk**

Electromagnetic emission at RHIC and LHC

Monday, 19 May 2014 11:40 (0:20)

On behalf of collaboration:

None

Abstract content

I will discuss the general features of the electromagnetic radiation from QCD matter using spectral functions in the hadronic phase and the OPE expansion in the partonic phase, and use them to analyze current di-lepton and photon emissions at collider energies both at RHIC and LHC. The large low mass di-lepton enhancement and photon v2 will be addressed.

Primary author(s) : Mr. ZAHED, Ismail (Stony Brook University)

Presenter(s) : Mr. ZAHED, Ismail (Stony Brook University)

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **629** Type : **Contributed Talk**

Systematics of the kinetic freeze-out properties in high-energy nuclear collisions from STAR

Wednesday, 21 May 2014 10:20 (0:20)

On behalf of collaboration:

STAR

Abstract content

The main aim of the RHIC Beam Energy Scan (BES) program is to explore the QCD phase diagram which includes search for a possible QCD critical point and the phase boundary between QGP and hadronic phase.

We report the collision energy and centrality dependence of kinetic freeze-out properties from the measured mid-rapidity light hadrons (pions, kaons, protons and their anti-particles) for Au+Au collisions at the center-of-mass energy root(s_nn) = 7.7, 11.5, 19.6, 27, and 39 GeV. The STAR detector, with a large uniform acceptance and excellent particle identification is used in the data taking. The kinetic freeze-out temperature (T_fo) and average collective velocity (beta) parameters are extracted from blast-wave fits to the identified hadron spectra and systematically compared with the results from other collision energies including those at AGS, SPS and LHC. It is found that all results fall into a correlation band in the 2-dimension (T_fo, beta) distribution: the largest value of collective velocity and lowest temperature is reached in the most central collisions at the highest collision energy. We study the energy dependence of these freeze-out parameters and implications of the systematics as a function of beam energy are also explored for particle and antiparticle separately.

Primary author(s) : KUMAR, Lokesh (National Institution of Science Education and Research)

Presenter(s) : KUMAR, Lokesh (National Institution of Science Education and Research)

Session Classification : Thermodynamics and hadron chemistry

Track Classification : Thermodynamics and Hadron Chemistry

Contribution ID : **634** Type : **Contributed Talk**

Correlations and higher-order flow: new heavy-quark observables in relation to the bulk dynamics

Monday, 19 May 2014 17:10 (0:20)

On behalf of collaboration:

None

Abstract content

The progress made by experimental collaborations in measuring heavy-flavor particles in heavy-ion collisions with unprecedented precision is accompanied by the advancement of theoretical calculations. Our recently developed model, which couples a Monte-Carlo Boltzmann-propagation of heavy quarks to the 3+1d fluid dynamical evolution from fluctuating EPOS initial conditions reproduces well the experimental data for the traditional observables like the nuclear modification factor and the elliptic flow.
In this talk we will discuss correlations and higher-order flow harmonics as new heavy-quark observables and demonstrate their potential to reveal properties of the QGP. Our studies show that correlations of heavy-flavor particles are sensitive to the energy loss mechanism. Experimentally feasible correlation observables can thus discriminate between elastic and radiative processes and provide valuable information about the transport coefficients. Higher-order flow harmonics, v_n, quantify the degree of thermalization of heavy quarks beyond our current understanding of the built-up of elliptic flow. By selecting special classes of bulk events from the probability distribution of v_n of light-flavor hadrons we discuss systematically how relating the light- and the heavy-flavor sector help us understand the interaction mechanisms and thermalization in the QGP.

Primary author(s) : Dr. NAHRGANG, Marlene

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Presenter(s) : Dr. NAHRGANG, Marlene

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **638** Type : **Contributed Talk**

Determination of freeze-out conditions from fluctuation observables measured at RHIC

Wednesday, 21 May 2014 12:10 (0:20)

On behalf of collaboration:

None

Abstract content

Fluctuations in the conserved charges of the strong interaction are important probes in high-energy heavy-ion collisions, which provide an excellent opportunity for revealing details in the phase structure of QCD matter. Recently, net-electric charge and net-proton fluctuations measured in the beam energy scan program at RHIC were reported by the STAR collaboration. In this talk, we present a new freeze-out curve, which is determined from a combined fit to these fluctuation observables within a phenomenological approach based on the hadron resonance gas model. We also point out that net-strangeness fluctuations may indicate a separate freeze-out behavior of strange hadrons. For a realistic description, we apply the relevant kinematic cuts and systematically include final state effects such as resonance decays and regenerations. The inclusion of the successive regeneration and decay of resonances turns out to be crucial for reconciling calculations of net-proton fluctuations with those of net-baryon number fluctuations and for obtaining reasonable freeze-out conditions.

Primary author(s) : Dr. BLUHM, Marcus (North Carolina State University)

Co-author(s) : ALBA, Paolo Giuseppe; Prof. ALBERICO, Wanda (University of Torino); BELLWIED, Rene (University of Houston (US)); MANTOVANI SARTI, Valentina (INFN Torino); Dr. NAHRGANG, Marlene; RATTI, Claudia

Presenter(s) : Dr. BLUHM, Marcus (North Carolina State University)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **639** Type : **Contributed Talk**

Jet (de)coherence in Pb-Pb collisions at the LHC

Wednesday, 21 May 2014 11:30 (0:20)

On behalf of collaboration:

None

Abstract content

We study the modifications of jets created in heavy-ion collisions at LHC energies. The inherent hierarchy of scales governing the jet evolution allows to distinguish a leading jet structure, which interacts coherently with the medium as a single color charge, from softer sub-structures that will be sensitive to effects of color decoherence. We argue how this separation comes about and show that this picture is consistent with experimental data on reconstructed jets at the LHC, providing a quantitative description simultaneously of the jet nuclear modification factor, the missing energy in di-jet events and the modification of the fragmentation functions. In particular, we demonstrate that effects due to color decoherence are manifest in the excess of soft particles measured in fragmentation functions in Pb-Pb compared to proton-proton collisions.

Primary author(s) : Dr. TYWONIUK, Konrad (Universitat de Barcelona)

Co-author(s) : MEHTAR-TANI, Yacine

Presenter(s) : Dr. TYWONIUK, Konrad (Universitat de Barcelona)

Session Classification : Jets

Track Classification : Jets

Contribution ID : **648** Type : **Contributed Talk**

Measuring and interpreting charge dependent anisotropic flow as a function of the event charge asymmetry

Tuesday, 20 May 2014 11:50 (0:20)

On behalf of collaboration:

None

Abstract content

Recently, the STAR Collaboration has reported a strong dependence of the elliptic flow of positive and negative pions on the net charge density [1]. This measurement attracted a lot of community attention, as the signal appeared to be of the magnitude and the sign of that predicted by the theory of the Chiral Magnetic Wave [2]. At the same time the interpretation of the results and further detailed study of the effect is rather difficult as the observable itself, the slope of elliptic flow value on the observed charge asymmetry in the STAR TPC acceptance, depends on the tracking efficiency and detector acceptance. In this talk we show how one can first make the observable robust (efficiency independent) and then make it suitable for many differential studies, not possible before. We use this observable, a three-particle correlator, in our model calculations to show the sensitivity of the signal to several background effects, such as local charge conservation, and propose experimental tests for further identification of the effects responsible for the observed signal.
[1] G.˜Wang [STAR Collaboration], "Search for Chiral Magnetic Effects in High-Energy Nuclear Collisions," Nucl.\ Phys.\ A904-905 {\bf 2013}, 248c (2013).
[2] Y.˜Burnier, D.˜E.˜Kharzeev, J.˜Liao and H.˜-U.˜Yee, "Chiral magnetic wave at finite baryon density and the electric quadrupole moment of quark-gluon plasma in heavy ion collisions," Phys.\ Rev.\ Lett.\ {\bf 107}, 052303 (2011).

Primary author(s) : BELMONT, Ron (Wayne State University (US)); Prof. VOLOSHIN, Sergei (Wayne State University)

Presenter(s) : Prof. VOLOSHIN, Sergei (Wayne State University)

Session Classification : Correlations and fluctuations

Track Classification : Correlations and Fluctuations

Contribution ID : **649** Type : **Contributed Talk**

Status of the FAIR Accelerators

Wednesday, 21 May 2014 11:10 (0:20)

On behalf of collaboration:

None

Abstract content

In 2018, a broad spectrum of unprecedented fore-front research becomes available at the Facility for Antiproton and Ion Research, FAIR. The new facility is being constructed within the next five years adjacent to the existing accelerator complex of the GSI Helmholtz Centre for Heavy Ion Research at Darmstadt/Germany. It will deliver stable and rare isotope beams covering a huge range of intensities and beam energies. The challenges are heavy ion synchrotrons for highest intensities, antiproton and rare isotope production stations, high resolution separators and several storage rings where beam cooling can be applied. Here new kind of superconducting magnets, rf-systems, injection and extraction systems and beam diagnostics will be applied. As the construction of the FAIR facility and procurement has started, an overview of the designs, procurements status and infrastructure preparation will be provided.

Primary author(s) : Dr. WEINRICH, Udo (GSI); Prof. KESTER, Oliver (GSI)

Presenter(s) : Dr. WEINRICH, Udo (GSI)

Session Classification : Future experimental facilities, upgrades, and instrumentation

Track Classification : Future Experimental Facilities, Upgrades, and Instrumentation

Contribution ID : **650** Type : **Contributed Talk**

A hybrid strong/weak coupling approach to jet quenching

Wednesday, 21 May 2014 12:30 (0:20)

On behalf of collaboration:

None

Abstract content

We propose and explore a new hybrid approach to jet energy loss in a strongly coupled medium. The basis of this phenomenological approach is to treat physics processes at different energy scales differently. The high-Q^2 processes associated with the QCD evolution of the jet from the hard production up to hadronization are treated perturbatively, following DGLAP evolution, to which we ascribe a space-time structure. The interactions of the shower partons with the deconfined matter leads to energy loss, which is dominated by soft processes and therefore, strong coupling effects are important. These interactions are modeled as inferred from studying energy loss of energetic probes via the gauge/gravity duality. We embed this hybrid model into a model for the production and expansion of hot QCD matter produced in heavy ion collisions and confront it to high energy jet data at the LHC. We also confront the results of this model to the energy loss mechanism dominant at weak coupling.

Primary author(s) : RAJAGOPAL, Krishna (Massachusetts Inst. of Technology (US)); GULHAN, Doga Can (Massachusetts Inst. of Technology (US)); TEIXEIRA DE ALMEIDA MILHANO, Guilherme (Universidade de Santiago de Compostela (ES)); CASALDERREY SOLANA, Jorge (University of Barcelona (ES)); PABLOS, Daniel (Universitat de Barcelona)

Presenter(s) : PABLOS, Daniel (Universitat de Barcelona)

Session Classification : Jets

Track Classification : QCD at High Temperature and/or Density

Contribution ID : **654** Type : **Contributed Talk**

Quarks in strong magnetic fields

Tuesday, 20 May 2014 10:20 (0:20)

On behalf of collaboration:

None

Abstract content

It has been known that magnetic fields enhance the chiral symmetry breaking (ChSB). According to studies of QED or models of the 4-fermi interactions, it was expected that the enhanced ChSB would resist the chiral restoration effects, increasing critical temperatures for the chiral restoration and deconfinement. Recent lattice calculations, however, showed the opposite behavior: the critical temperatures are reduced as a magnetic field increases. I will discuss how to resolve this apparent paradox, emphasizing which characteristic features of QCD make differences from other models.

Primary author(s) : KOJO, Toru (Bielefeld University)

Co-author(s) : Dr. SU, Nan (Bielefeld University)

Presenter(s) : KOJO, Toru (Bielefeld University)

Session Classification : QCD phase diagram

Track Classification : QCD Phase Diagram

Contribution ID : **659** Type : **Contributed Talk**

Ω and ϕ production in p+p, Au+Au and U+U collisions at STAR

Wednesday, 21 May 2014 09:20 (0:20)

On behalf of collaboration:

STAR

Abstract content

Multi-strange hadrons are excellent probe to the hadronization of the hot and dense medium produced in heavy ion collisions, since they may decouple earlier from the hadronic system. The STAR measurements of Ω to ϕ ratio and Ω, ϕ nuclear modification factors at intermediate p_{T} at top RHIC energies are consistent with expectations from recombination/coalescence models, which assume a seemingly thermalized partonic medium created at RHIC. However, the limited statistics put large uncertainties in those measurements. The high-statistics p+p, Au+Au and U+U data collected by STAR during the years of 2011 and 2012 will enable a high-precision systematic survey of these observables. Comparing data from Au+Au and U+U collisions also allows us to identify possible different medium properties due to different system size.

In this talk, we present the measurements of Ω and ϕ production in $\sqrt{s}$ = 200 GeV p+p, $\sqrt{s_{NN}}$ = 200 GeV Au+Au, 193 GeV U+U collisions. The Ω, ϕ nuclear modification factors and Ω to ϕ ratios will be presented for both Au+Au and U+U up to $p_T \sim 6$ GeV/c. Strangeness enhancement factors for Ω and ϕ in U+U, Au+Au with respect to p+p collisions will be presented as well. Implications on collision dynamics will be discussed.

Primary author(s) : Mr. HAN, Zhiyu (Tsinghua University); ZHU, Xianglei (Tsinghua University)

Presenter(s) : ZHU, Xianglei (Tsinghua University)

Session Classification : Thermodynamics and hadron chemistry

Track Classification : Thermodynamics and Hadron Chemistry

Contribution ID : **660** Type : **Contributed Talk**

Theoretical predictions of jet suppression: a systematic comparison with RHIC and LHC data

Monday, 19 May 2014 11:00 (0:20)

On behalf of collaboration:

None

Abstract content

Accurate theoretical predictions of jet suppression are necessary for studying the properties of QCD matter created in ultra-relativistic heavy ion collisions. However, testing the prediction accuracy - and extracting useful qualitative knowledge - is often limited by constraining the predictions to only few experimental probes at a time, and by using free parameters. To address this issue, we will present comprehensive suppression predictions, which run across all available probes and different centrality regions at RHIC and LHC. To generate these predictions, we use the finite size dynamical QCD formalism that we previously developed, together with its recent extensions to finite magnetic mass [1] and running coupling [2]; this formalism is integrated into a numerical procedure that uses no free parameters in model testing. We obtain a very good agreement with the experimental results across all particle species [2,3], for different centrality regions [4], and for both RHIC and LHC. We will also discuss improved qualitative understanding of the relevant experimental data, which follows from such comprehensive comparison.

1. M. Djordjevic and M. Djordjevic, Physics Letters B 709, 229 (2012).
2. M. Djordjevic and M. Djordjevic, arXiv:1307.4098
3. M. Djordjevic, Phys.Rev.Lett. 112, 042302 (2014).
4. M. Djordjevic, M. Djordjevic and B. Blagojevic, to be submitted.

Primary author(s) : Dr. DJORDJEVIC, Magdalena (Institute of Physics Belgrade, University of Belgrade)

Presenter(s) : Dr. DJORDJEVIC, Magdalena (Institute of Physics Belgrade, University of Belgrade)

Session Classification : Heavy flavor

Track Classification : Open Heavy Flavour and Quarkonia

Contribution ID : **673** Type : **Contributed Talk**

Probing dense matter in compact star cores with radio pulsar data

Tuesday, 20 May 2014 09:00 (0:20)

On behalf of collaboration:

None

Abstract content

Astrophysical observations of compact stars provide, in addition to collider experiments, the other big source of information on matter under extreme conditions. The largest and most precise data set about neutron stars is the timing data of radio pulsars. We show how this unique data can be used to learn about the ultra-dense matter in the compact star interior. The method relies on astro-seismology based on special global oscillation modes (r-modes) that emit gravitational waves. They would prevent pulsars from spinning with their observed high frequencies, unless the damping of these modes, determined by the microscopic properties of matter, can prevent this. We show that for each form of matter there is a distinct region in a frequency/spindown-rate diagram where r-modes can be present. We find that stars containing quark matter are consistent with both the observed radio and x-ray data, whereas for standard neutron stars so far unestablished, enhanced damping mechanisms would be required.

Primary author(s) : ALFORD, Mark (Washington University, St Louis); SCHWENZER, Kai (W)

Presenter(s) : SCHWENZER, Kai (W)

Session Classification : QCD phase diagram

Track Classification : New Theoretical Developments

Contribution ID : **678** Type : **Contributed Talk**

The QCD phase diagram in the region of moderate temperature and high baryon density: study of dimuon production in the 20-160 AGeV interval at the CERN SPS

Monday, 19 May 2014 17:50 (0:20)

On behalf of collaboration:

None

Abstract content

The structure of the QCD phase diagram in the region of moderate temperature and high baryon density is still almost unexplored. In this regime, the QGP and hadronic phases should be separated by a first order transition region. On the other hand, for sufficiently low baryonic chemical potential a simple cross-over is expected. The end point of the first order transition region is the so called critical point.
Measurements of the ratio K^+/π^+ vs energy performed at the CERN SPS by the NA49 collaboration showed that the early stage produced in central Pb-Pb collisions at E_{lab}=30-40 AGeV may have reached the transition line - marking the onset of deconfinement. However, this interpretation is still controversial. Dilepton measurements with a rich set of independent observables offer a completely independent way to shed light on the onset of deconfinement and at the same time on the issue of chiral restoration. The CERN SPS is unique for systematic investigations along these lines, due to its wide beam energy range from 20-160 AGeV coupled to very high luminosities over the full range.
The objective of this talk is to present a new proposal for measuring dimuon production in a comprehensive energy scan at the SPS - specifically both below and above the maximum of the K^+/π^+ ratio. To advance the field with measurements which could provide quantitative insight, a further significant increase in the precision and in the collected statistics with respect to the past reference experiment NA60 is needed. To this end, we propose a novel NA60-like apparatus, with improved performance, based on the coupling of a muon spectrometer to a a silicon pixel spectrometer in the vertex region before the absorber.
The first key element is a high-precision measurement of the temperature T of the thermal dimuon continuum in the mass range $1.1 M 2.5$ GeV (IMR) vs. beam energy. The temperature is accessible through the spectral shape of the mass spectra, and since mass is a Lorentz-invariant, T is immune to any motion of the emitting sources and thus purely thermal, in contrast to the slope parameters of dilepton m_T spectra or photon p_T spectra. At top SPS energies, values of about 200 MeV were found, indicating dominantly partonic emission sources. For decreasing beam energies one should expect that the partonic contribution will also decrease, becoming negligible at the onset of deconfinement. Thus the onset of deconfinement might be tagged by a precision measurement of T in the IMR.
The second element is related to the transverse momentum spectra, which encode - besides temperature - also radial flow, another key property of the fireball. At topmost SPS energies the effective temperature extracted from the m_T spectra vs mass shows an increase up to $M \sim 1$ GeV corresponding to ρ production which is maximally coupled to radial flow through pions. At 1 GeV a sudden drop occurs and the temperature is constant at 180-200 MeV - a sign of production of thermal dimuons from the partonic medium without any flow (at the SPS). The evolution of the pattern of T_{eff} vs. M towards lower energies, in particular the possible decrease or disappearence of the drop, will be most revealing: thermal radiation

from multi-pion processes should exhibit a monotonic increase of T_{eff} vs M so that around the onset of deconfinement the drop should vanish.
The new experiment should reach a sensitivity at the MeV level in the measurements of T and T_{eff} vs M. This will be possible integrating luminosities at least an order of magnitude larger than in case of NA60 or so while retaining a good signal to background ratio - well above than 1/100 in the IMR even in Pb-Pb central collisions.
For masses below 1 GeV (LMR), at high energies, hadronic many body models describe ρ production and the notion that the total baryon density drives the broadening is now well accepted. At lower energies, the baryon density gets maximal, thus the effects of ρ broadening can be measured with utmost precision. In this measurement the mass resolution is a key factor and we propose to improve it over NA60 by a factor 2-3, reaching $\sim$10 MeV at the ω mass.
The experimental apparatus must have also a good p_T-y coverage down to the lowest beam energies. In the talk the detector perfomance in terms of acceptances at different energies and mass resolution will be discussed in detail. The physics performance will be presented on the basis of simulations of Pb-Pb collisions at 20 and 40 AGeV including a background estimate and a modeling of the involved physics processes - in medium ρ in the LMR, multi-pion processes and partonic radiation in the IMR. An overview of the possible detector technologies together with a cost estimate will be also presented. Finally, an experimental program consisting of measurements at different energies and/or different collision systems will be discussed in terms of beam time needed to collect the required event statistics.

Primary author(s) : USAI, Gianluca (Universita e INFN (IT))

Presenter(s) : USAI, Gianluca (Universita e INFN (IT))

Session Classification : Electromagnetic probes

Track Classification : Electromagnetic Probes

Contribution ID : **680** Type : **Contributed Talk**

Rapidity evolution of Wilson lines at the next-to-leading order: Balitsky-JIMWLK equation at NLO

Tuesday, 20 May 2014 12:10 (0:20)

On behalf of collaboration:

None

Abstract content

Scattering amplitudes of proton-Nucleus or Nucleus-Nucleus collisions at high-energy are described by matrix elements of Wilson line operators - infinite gauge factors ordered along the straight lines of the fast moving particles. The energy dependence of such amplitudes is described by the evolution equation of Wilson lines with respect to the rapidity parameter - the Balitsky-JIMWLK evolution equation. Most of the current phenomenology of high-energy and high-density QCD is based on the leading-order evolution equation with only running coupling corrections. In my talk I will present the derivation of the Balitsky-JIMWLK evolution equation at the next-to-leading order.

Primary author(s) : CHIRILLI, Giovanni Antonio (The Ohio State University)

Presenter(s) : CHIRILLI, Giovanni Antonio (The Ohio State University)

Session Classification : New theoretical developments

Track Classification : New Theoretical Developments

Contribution ID : **681** Type : **Contributed Talk**

Beam energy dependence of the viscous damping of anisotropic flow

Monday, 19 May 2014 14:20 (0:20)

On behalf of collaboration:

None

Abstract content

The flow harmonics $v_{2,3}$ for charged hadrons, are studied for a broad range of centrality selections and beam collision energies in Au+Au ($\sqrt{s_{NN}} = 7.7 - 200$ GeV) and Pb+Pb ($\sqrt{s_{NN}} = 2.76$ TeV) collisions. They validate the characteristic signature expected for the system size dependence of viscous damping at each collision energy studied. The extracted viscous coefficients, that encode the magnitude of the ratio of shear viscosity to entropy density η/s, are observed to decrease to an apparent minimum as the collision energy is increased from $\sqrt{s_{NN}} = 7.7$ to approximately 62.4˜GeV; thereafter, they show a slow increase with $\sqrt{s_{NN}}$ up to 2.76 TeV. This pattern of viscous damping provides the first experimental constraint for η/s in the temperature-baryon chemical potential (T, μ_B) plane, and could be an initial indication for decay trajectories which lie close to the critical end point in the phase diagram for nuclear matter.

Primary author(s) : LACEY, Roy (Stony Brook University)

Presenter(s) : LACEY, Roy (Stony Brook University)

Session Classification : Collective dynamics

Track Classification : QCD Phase Diagram

Contribution ID : **682** Type : **Contributed Talk**

Gluon radiation by heavy quarks at intermediate energies

Monday, 19 May 2014 17:30 (0:20)

On behalf of collaboration:

None

Abstract content

It is generally admitted that heavy quarks (c and b) created in the early stage of ultrarelativistic heavy ion collisions through hard processes are among the best probes of the later QGP stage. Perturbative QCD allows for the calculation of the production cross sections (in contradistinction to light quarks) and these cross sections have also been measured. Also the details of the chiral/confinement phase transition are less important than for light quarks because, due to its mass, the momentum of the heavy quark determines the momentum of the open charm hadrons. In addition, the momentum distribution at production and at the transition is very different from that expected if the heavy quarks are in thermal equilibrium with the plasma of light quarks and gluons. Therefore the modification of the initial momentum distribution by the interaction of the heavy quarks with the plasma carries information on the plasma properties.

The interaction of the heavy quark with the plasma has two parts, elastic collisions and radiative collisions. For the first a model was developed [1] in which the cross section of the elementary interactions are calculated by perturbative QCD with a running coupling constant and an infrared behavior adjusted so as to match hard thermal loop calculations. Embedding these cross sections in the hydrodynamical description of the expanding plasma of Heinz and Kolb it was shown that the collisional energy loss underpredicts the measured energy loss of heavy mesons at large momenta as well as their elliptic flow by roughly a factor of two.

It is the purpose of the present work to extend our pQCD calculation toward the calculation of the radiative energy loss for heavy quarks at intermediate energies. To this end we compute the gluon emission cross section of a heavy quark colliding a light parton from the plasma in pQCD at leading order [2]. We first derive the high-energy approximation that naturally extends results obtained by Gunion and Bertsch for the light quark sector to heavy quarks. We next show that it is possible to compute the complete energy dependence of the result. This allows us to assess the range of applicability in energy of the high-energy approximation. We then extend the calculation to the case of intermediate energy, for which the invariant mass s in the collision does not exceed the squared heavy quark mass m_Q^2 in large amounts. We discuss in particular the relevance of the dead cone effect as well as the consequences of a finite heavy quark energy, which is often neglected in the literature. For this purpose, we address quantities such as the average energy loss in a bath at finite temperature as well as the nuclear modification factor as a function of the transverse momentum.

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[2] J. Aichelin, P.B. Gossiaux and Th. Gousset arXiv:1307.5270, TBP in PRD

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Co-author(s) : AICHELIN, Joerg (University of Nantes); Prof. GOUSSET, Thierry (SUBATECH)

Presenter(s) : GOSSIAUX, Pol (Subatech)

Session Classification : Heavy flavor

Track Classification : New Theoretical Developments

Contribution ID : **685** Type : **Contributed Talk**

Energy dependence of higher moments of net-kaon, net-proton and net-charge multiplicity distribution at STAR

Wednesday, 21 May 2014 11:10 (0:20)

On behalf of collaboration:

STAR

Abstract content

The main goal of the Beam Energy Scan (BES) program at RHIC is to map the phase diagram of QCD. A critical point (CP) is expected at large baryonic chemical potential (μ_B) in the T vs. μ_B phase diagram. Its location experimentally will provide one of the most stringent tests of QCD calculations. In the BES program T and μ_B are varied by changing the center of mass energy ($\sqrt{s_{NN}}$) from 200 to 7.7 GeV. The observables chosen for CP search are the product of moments of conserved(like net-charge) multiplicity distributions or their proxies (such as net-kaon for net-strangeness and net-proton for net-baryons) measured in the experiments. The various moments (mean (M), standard deviation (σ), skewness (S) and kurtosis (κ)) are related to correlation length (ξ) of the system (variance: $\sigma^2 \sim \xi^2$; skewness: $S \sim \xi^{4.5}$ and kurtosis: $\kappa \sim \xi^7$) [1] and are expected to show a non-monotonic variation with beam energy in the presence of CP.
We report new measurements of product of moments: σ^2/M, $S\sigma$ and $\kappa\sigma^2$ of net-kaon distributions ($\Delta N_K = N_K^+$ - N_K^-) obtained by the STAR detector at midrapidity for various centrality in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 11.5, 19.6, 27, 39, 62.4 and 200 GeV. These results will be presented along with the corresponding results from net-charge [2] and net-proton distributions[3]. All the results are corrected for particle reconstruction efficiency and will be compared to baseline distributions constructed following Poisson and Negative Binomial/Binomial statistics. They will also be compared to calculations from HIJING, AMPT and UrQMD models, which do not include a CP. Deviations from some of the baseline measures and model calculations are observed for net-kaon and net-proton distributions. The implications of the observation to CP physics will be presented.
References

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2. L. Adamczyk, et al., (STAR Collaboration), arXiv:1402.1558.
3. L. Adamczyk, et al., (STAR Collaboration), Phys. Rev. Lett. 112,

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Charge asymmetry dependency of π/K anisotropic flow in U+U and Au+Au collisions at STAR

Tuesday, 20 May 2014 10:00 (0:20)

On behalf of collaboration:

STAR

Abstract content

Theoretical studies [1] indicate that in relativistic heavy collisions a chiral magnetic wave at finite baryon density could induce an electric quadrupole moment, which will lead to a difference in elliptic flow of hadrons with opposite charge. The magnitude of this difference is predicted to be proportional to the charge asymmetry $A_{\rm ch}$, defined as $A_{\rm ch} \equiv \langle (N_+ - N_-)\,/\,(N_+ + N_-) \rangle$. Charge-asymmetry dependency of the pion elliptic flow has been observed in Au+Au collisions at the STAR experiment. On the other hand, it is argued that the local charge conservation at freeze-out, together with the characteristic shape of $v_2(\eta)$ and $v_2(p_{\rm T})$, may also contribute to elliptic flow splitting as a function of $A_{\rm ch}$. This can be manifested by implementing the corresponding measurement for higher flow harmonics v_3 [2].

Here, we present STAR's measurements of v_2 and v_3 for charged pions and kaons at low transverse momentum range ($0.15 < p_{\rm T} < 0.5$ GeV/c), as a function of event charge asymmetry ($A_{\rm ch}$) in both U+U collisions at $\sqrt{s_{\rm NN}}$ = 193 GeV and Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 200 GeV. Our measurements for both collision systems serve as important consistency checks for the phenomena suggested as the consequence of the chiral magnetic wave.

[1] Burnier Y, Kharzeev D E, Liao J and Yee H U 2011 *Phys.Rev.Lett* **107** 052303

[2] Bzdak A and Bozek P 2013 *PhysicsLettersB* **726** 239-243

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Jet quenching in strongly coupled plasma

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None

Abstract content

We present calculations in which a light quark shoots through a finite slab of strongly coupled $\mathcal{N} = 4$ supersymmetric Yang-Mills plasma, with thickness L, focussing on what comes out on the other side. We find that even when the "jets'" that emerge from the plasma have lost a substantial fraction of their energy they look in almost all respects like "jets" in vacuum with the same reduced energy. The one possible exception is that the opening angle of the "jet" is larger after passage through the slab of plasma than before. Along the way, we obtain a fully geometric characterization of energy loss in the strongly coupled plasma and show that $dE_{\rm out}/dL$ is proportional to $L^2/\sqrt{x_{\rm stop}^2 - L^2}$, where $E_{\rm out}$ is the energy of the "jet" that emerges from the slab of plasma and $x_{\rm stop}$ is the (previously known) stopping distance for the light quark in an infinite volume of plasma.

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