Strangeness in Quark Matter

Sunday 21 July 2013 - Saturday 27 July 2013

The University of Birmingham

Book of Abstracts

Contents

Opening talks / 145

Welcome and VC Address

Opening talks / 144

A Snapshot of our Experimental Knowledge Circa Winter 2012-13

Corresponding Author: helen.caines@yale.edu

Opening talks / 143

Strangeness in Quark Matter: Opening Talk

Corresponding Author: bleicher@th.physik.uni-frankfurt.de

Plenary 1 / 162

Strangeness overview Experiment

Corresponding Author: boris.hippolyte@cern.ch

Plenary 1 / 163

Strangeness overview Theory

Corresponding Author: becattini@fi.infn.it

Plenary 2 / 167

Overview of results from ALICE

Corresponding Author: mploskon@lbl.gov

Plenary 2 / 133

Recent Results on Strangeness Production at STAR

Author: Xianglei Zhu[1]

[1] *Tsinghua University*

Corresponding Author: zhux@tsinghua.edu.cn

Strange hadron productions are sensitive probes to the dynamics of the hot and dense matter created in heavy-ion collisions. In this talk, we will present the recent STAR measurements on the production of various strange hadrons (K0s, phi, Lambda, Xi and Omega) in $\sqrt{S_{NN}}$ = 7.7 - 39 GeV Au+Au collisions in the STAR beam energy scan program. We will investigate the collision energy dependence of the strangeness enhancement, nuclear modification factors, baryon to meson ratios, as well as the phi meson elliptic flow. We will present the extracted chemical and kinetic freeze-out parameters with the thermal and blast wave models as a function of energy and centrality. The physics implications of these measurements on the collision dynamics will be discussed.

Plenary 2 / 108

Identified charged hadron spectra and ratios in PHENIX

Author: Ron Belmont[1]

[1] *University of Michigan, Wayne State University*

PHENIX has recently reported[arXiv:1304.3410] measurements of identified charged hadron spectra and ratios in Au+Au and d+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. Identified hadrons are an important probe of both hot and cold nuclear matter. The intermediate p_T region, 2 -5˜GeV/c, is of particular interest. In Au+Au collisions, the production of mesons is suppressed in this p_T region relative to that in p+p collisions, while the production of baryons is nearly unmodified. On the other hand, in d+Au collisions, the meson production exhibits a slight enhancement in this p_T region while the baryon production exhibits a much stronger enhancement. In this talk, the p_T spectra and ratios of identified charged hadrons $\pi^{\pm}$, $K^{\pm}$, p, and $\bar{p}$ in 5 different centrality classes for each collision species will be presented. Implications for particle production will be discussed.

Plenary 2 / 147

Strangeness in ALICE

Corresponding Author: lee.stuart.barnby@cern.ch

Plenary 3 / 149

Heavy Flavours and Quarkonia

Corresponding Author: raphael@cern.ch

Plenary 3 / 148

Open and Hidden Heavy Flavor Production in pp, pA and AA Collisions

Corresponding Author: rlvogt@lbl.gov

Plenary 4 / 150

ALICE results on quarkonium production in pp, p-Pb and Pb-Pb collisions

Corresponding Author: giuseppe.bruno@cern.ch

Plenary 4 / 151

Heavy flavour production at STAR

Author: Daniel Kikola[1]

[1] *Warsaw University of Technology*

Corresponding Author: dkikola@gmail.com

Heavy quarks are produced early in the heavy-ion collisions and they are expected to interact differently from light quarks with the Quark Gluon Plasma (QGP); therefore, they are unique probes of the QGP properties. Moreover, their production and elliptic flow are sensitive to the medium dynamics. These measurements for open heavy flavour sector are crucial for understanding the parton energy loss mechanism and the degree of thermalization of the QGP. They can be also used to determine the transport coefficients of the QGP. Furthermore, production of various quarkonia states can provide insight into thermodynamic properties of the QGP since different states are predicted to disassociate (due to the Debye screening of the quark-antiquark potential) at different temperatures.

In this talk, we report on recent STAR results on heavy flavour production at $\sqrt{s_{NN}}$ = 200, 62.4 and 39 GeV. We present nuclear modification factor and elliptic flow of open charm mesons and electrons from semileptonic decays of heavy flavor hadrons. We also report on new measurement of energy dependence of the J/psi production. STAR data are compared to theoretical model calculations and physics implications are discussed.

Plenary 4 / 111

Quarkonia and heavy flavors latest PHENIX results

Author: Denis Jouan[1]

[1] *IPN CNRS/IN2P3*

Corresponding Author: jouan@in2p3.fr

Heavy quarks and quarkonia are mostly produced in the first steps of a collision, and then are sensitive to the whole evolution of the system, and in particular to the initial stage, which makes also of

the heavy quarkonia an excellent probe of the quark gluon plasma formation in heavy ion collisions. Other effects also occur, such as partonic distributions modification in cold nuclear matter, and a multidimensional description is necessary to get a sufficient set of equations to disentangle the various contributions. In particular, the characterization of the production processes in p-p and p or d induced collisions with ions is critical in the extraction of the additional ion-ion collisions effect.
The Relativistic Heavy Ion Collider has been delivering the widest range of systems and energies, from p-p to Au-Au through d-Au and Cu-Au, from 7.6 to 200 GeV (n-n collision), allowing the PHENIX experiment to start to explore these various experimentally available dimensions, also versus rapidity and transverse momentum, for open and hidden charm and beauty.
Recent PHENIX results of their production through single lepton or pairs of leptons, including J/psi, psiprime, Chi_c, Upsilon, open charm and beauty, will be presented.

Plenary 5 / 152

Open heavy-flavour results from ALICE

Corresponding Author: diego.stocco@cern.ch

Plenary 5 / 94

Open and closed heavy-flavour suppression in heavy-ion collisions with CMS

Authors: Mihee Jo[1]; The CMS Collaboration[2]

[1] *Korea University (KR)*

[2] *CMS*

Corresponding Authors: mihee.jo@cern.ch, sergeant@mail.cern.ch

The Compact Muon Solenoid (CMS) is fully equipped to measure quarkonia in the di-muon decay channel in the high multiplicity environment of nucleus-nucleus collisions. Quarkonia are especially relevant for studying the quark-gluon plasma since they are produced at early times and propagate through the medium, mapping its evolution. CMS has measured the nuclear modification factors of non-prompt J/psi (from b-hadron decays), prompt J/psi, inclusive psi(2S), and the first three Y states in PbPb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV. A suppression of non-prompt J/psi, which is sensitive to the in-medium b-quark energy loss, has been measured at relatively high p_T (6.5 < p_T < 30 GeV/c) in PbPb collisions, compared to the yield in pp collisions scaled by the number of inelastic nucleon-nucleon collisions. For prompt J/psi in the same kinematic range, a strong, centrality-dependent suppression is observed. Such strong suppression at high p_T has previously not been observed at RHIC. At midrapidity and high p_T, psi(2S) show an even stronger suppression than J/psi. Furthermore, CMS has measured the suppression of the three Y states, separately, down to p_T = 0. A clear ordering of the suppression with binding energy is observed, as expected from sequential melting. The status of quarkonium measurements in pPb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV will be also presented.

Plenary 5 / 154

Strange particle production in Monte Carlo generators in pp and pPb collisions at the LHC

Author: Klaus Werner[1]

[1] *SUBATECH*

Corresponding Author: werner@subatech.in2p3.fr

Low Energy / Heavy Flavour / 17

Influence of the in-medium kaon potential on kaon production in heavy ion collisions

Authors: Ayut Limphirat[1]; Kristiya Tomuang[2]; Pavadee Boonthus[3]; Sukanya Sombun[3]; Ukrit Chaimongkon[4]; Yu-Ming Zheng[5]; Yu-peng Yan[6]

Co-author: Pornrad Srisawad [2]

[1] *School of Physics, Suranaree University of Technology, 3000 Nakhon Ratchasima, Thailand*

[2] *Department of Physics, Faculty of Science, Naresuan University, 65000 Phitsanulok Thailand*

[3] *Department of Physics, Faculty of Science, Naresuan University, 65000 Phitsanulok Thailand.*

[4] *School of Science, University of Phayao, 56000 Phayao, Thailand*

[5] *China Institute of Atomic Energy, P.O. Box 275(18),102413 Beijing, China*

[6] *School of Physics, Suranaree University of Technology, 3000 Nakhon Ratchasima, Thailand.*

Corresponding Author: pornrads@gmail.com

The inclusive cross section, polar angle distribution and the direct transverse momentum of K+ mesons in C + C, Ni + Ni and Au + Au collisions at incident energies from 0.6 to 2.0 A GeV are studied using the Quantum Molecular Dynamics model based on the covariant kaon dynamics, and compared with the KaoS data of GSI. The calculated K+ yields consist with experiment data for a soft and hard nuclear equation of state (compression modulus K = 200 , 380 MeV respectively) when including the in-medium K+ potential (its value at saturation density is). The experimental data for the polar distribution of Au + Au collisions at 1.5 A GeV and Ni + Ni collisions at 1.93 A GeV are slightly more forward/back than theoretical predicts and rather flat. The direct transverse momentum of K+ mesons in Ni + Ni collisions at 1.93 A GeV is not obviously affected by the in-medium K+ potential.

Summary:

The calculated inclusive cross sections of K+ mesons in C + C, Ni + Ni and Au + Au collisions at incident energies from 0.6A to 2.0A GeV using Quantum Molecular Dynamics model are consistent with the experiment KaoS data when including the in-medium K+N potential. The experimental data for the polar distribution of Au + Au collisions at 1.5 A GeV and Ni + Ni collisions at 1.93 A GeV are slightly more forward/back than theoretical predicts and rather flat. The sensitivity of the direct transverse momentum of K+ mesons in Ni + Ni collisions at 1.93 A GeV on the in-medium K+ potential is weak .

Strangeness 1 / 30

System-size dependence of charged kaon and pion production in nucleus-nucleus collisions at beam energies of 40A GeV and 158A GeV

Author: Herbert Stroebele[1]

[1] *Johann-Wolfgang-Goethe Univ. (DE)*

Corresponding Author: stroebel@ikf.uni-frankfurt.de

The NA49 collaboration measured the rapidity and
transverse mass distributions of kaons and pions in

Pb+Pb collisions at different centralities. These data are complemented by results from the small systems C+C and Si+Si. We find that the centrality dependence of kaon and pion production is reproduced by microscopic transport model calculations (HSD and UrQMD2.3) within 20% or better. The mean transverse mass evolves with centrality as expected for increased stopping and energy deposition. The centrality dependence of the widths of the rapidity distributions in Pb+Pb collisions does not smoothly connect to results from the small systems p+p, C+C, and Si+Si. In Pb+Pb collisions the K/π ratios show a smooth increase with centrality at both beam energies with saturation setting in around 100-200 (60-100) wounded nucleons for 40A GeV (158A GeV). This behavior fits well into the trends observed at lower (AGS) and higher (RHIC) energies.

Flow / 65

Anisotropic flow of identified particles in Pb-Pb collisions at √ sN N = 2.76 TeV with the ALICE detector

Author: You Zhou[1]

[1] *NIKHEF and Utrecht University (NL)*

Corresponding Author: you.zhou@cern.ch

Anisotropic flow is an important observable to study the properties and the evolution of the system created in heavy-ion collisions. We present measurements of anisotropic flow of strange and multi-strange particles, including Ks, Λ, Ξ, Ω and φ, in Pb–Pb collisions at \sqrt{s_{NN}} = 2.76 TeV recorded with the ALICE detector. The results are compared to hydrodynamic model calculations, blast-wave fit and the measurements at top RHIC energy. Particle mass dependence and scaling with the number of quarks of the anisotropic flow will be also discussed.

Flow / 122

Recent ATLAS results on flow measurements in lead-lead and proton-lead collisions

Author: Adam Trzupek[1]

[1] *Henryk Niewodniczanski Inst. Nucl. Physics, PAN*

Corresponding Author: adam.trzupek@cern.ch

ATLAS has performed a detailed measurement of event-by-event flow in lead-lead collisions at the LHC. The Fourier coefficients, v2-v4, of the azimuthal angle distribution of charged particles measured in the ATLAS inner detector (|eta| < 2.5) are extracted in each of 48 million minimum-bias Pb+Pb collisions. The v2-v4 distributions are measured for a variety of centrality intervals over three transverse momentum ranges, pT > 0.5 GeV, pT > 1 GeV and 0.5 < pT < 1 GeV. The measurements of the vn distributions, unfolded for experimental resolution will be presented. The relationship between the shapes of the vn distributions and the collision geometry and initial-state fluctuations will be discussed. The results will be compared with theoretical

calcualtions of initial-state eccentricity distributions and
theoretical calculations of the vn distributions using hydrodynamics.

Strangeness 1 / 34

Status and results from the NA61/SHINE experiment at the CERN SPS

Author: Andras Laszlo[1]

[1] *Hungarian Academy of Sciences (HU)*

Corresponding Authors: zoltan.fodor@cern.ch, andras.laszlo@cern.ch

Present status and recent results shall be presented from the NA61/SHINE experiment at the CERN SPS. The physics program is concentrated along heavy-ion physics and the study of hadron production in p+p and h+A collisions. The heavy-ion program mostly address the study of onset of deconfinement and search for the critical point of the strongly interacting matter, while the p+p and h+A program is also meant to provide valuable reference data for neutrino beam experiments and large coverage cosmic shower observatories.

The quantitative results to be shown are identified charged pion and Kaon production spectra in p+C collisions, along with preliminary K^0_s and Lambda yields. These results are mostly used by neutrino beam communities. Preliminary identified charged pion, Kaon and proton spectra in p+p collisions shall also be presented. These data are mostly relevant for the heavy-ion program of NA61 as a baseline. Along with single particle spectra, results on the energy and system size dependence on event-by-event fluctuation measures shall also be presented.

Finally, the near plans and farther future perspectives shall also be mentioned, such as the Pb+Pb energy scan and open charm measurement possibilities.

Low Energy / Heavy Flavour / 3

Phenomenology of quarkyonic matter in heavy-ion collisions

Author: Giorgio Torrieri[1]

[1] *JW Goethe Universitat, Frankfurt*

Corresponding Author: lunogled@gmail.com

I will discuss the phase structure of matter at moderate temperature
and chemical potential, relevant for the lower energy runs at RHIC as
well as the upcoming experiments of NICA and FAIR.
Motivated by large Nc physics, I will argue that the non-perturbative structure of QCD can give rise to hitherto little explored phenomena, such as the coexistence of confinement with perturbative quark degrees of freedom. I will however show that this "quarkyonic phase" is defined by a percolation-type phase transition line which curves in "number of colors", as well as density and temperature.
Given theoretical uncertainities in dealing with matter at this regime, therefore, a phenomenological and experimental investigation
of matter at high chemical potential might be decisive to determine if the quarkyonic phase does in fact exist.
I will discuss possible experimental signatures of this new state of matter,concentrating on electromagnetic signals as well as strangeness enhancement.

Summary:

Based on Phys.Rev.Lett. 107 (2011) 152301
and developments of this work, arXiv:1204.3272 and arXiv:1302.1119

Flow / **66**

Thermalization of massive partons in anisotropic medium

Author: Wojciech Florkowski[1]

Co-author: Radoslaw Ryblewski [2]

[1] *Institute of nuclear Physics, Krakow*

[2] *Institute of Nuclear Physics PAS*

Corresponding Authors: radoslaw.ryblewski@ifj.edu.pl, wojciech.florkowski@ifj.edu.pl

At first, we exactly solve the relaxation-time approximation Boltzmann equation for a system which is transversely homogeneous and undergoing boost-invariant longitudinal expansion. We compare the resulting exact numerical solution with approximate solutions available in the anisotropic hydrodynamics and second order viscous hydrodynamics frameworks. In all cases studied, we find that the anisotropic hydrodynamics framework is a better approximation to the exact solution than traditional viscous hydrodynamical approaches. In the next step we generalize the kinetic approach to include finite parton masses and analyze their impact on the thermalization process.

The talk is partially based on the recent eprint: "Anisotropic Hydrodynamics for Rapidly Expanding Systems" by W. Florkowski, R. Ryblewski, and M. Strickland, arXiv:1304.0665

Strangeness 1 / **69**

Production of pi/K/p in pp and Pb-Pb collisions measured with ALICE.

Author: Marek Chojnacki[1]

[1] *University of Copenhagen (DK)*

Corresponding Author: marek.chojnacki@cern.ch

The ALICE detector features multiple particle identification systems including: the Time Projection Chamber (TPC), the Inner Tracking System (ITS), a time-of-flight system (TOF) and a Ring-imaging Cherenkov detector (HMPID).
This combination of detectors along with the excellent tracking capabilities of ALICE provides us with the opportunity to measure the production of pi/K/p over a broad transverse momentum (pT) range, from 100 MeV/c up to 20 GeV/c.
Particle identification at low pT (below 1GeV/c) is performed using the energy loss of particles in the ITS and the TPC. The TOF contributes to the identification for the pT range between 0.5 GeV/c and 3-5 GeV/c (depending on the particle type and the colliding system). For high pT (up to 20 GeV/c), particles are identified with the HMPID or the relativistic rise of the energy loss in the TPC.
In this talk an overview of the ALICE results on the production of pi/K/p in pp collisions at sqrt(s) = 0.9, 2.76 and 7 TeV, and Pb-Pb collisions at sqrt(s_NN) = 2.76 TeV will be presented. The ALICE results from pp collisions provide constraints for the commonly used event generators and are the baseline for the Pb-Pb measurement. The Pb-Pb results will be compared to statistical models and hydrodynamic calculations at low pT and recombination models at intermediate pT. The high

pT region provides constraints on models describing parton energy loss in the hot and dense medium.

Low Energy / Heavy Flavour / 43

Strongly interacting parton-hadron matter in- and out-off equilibrium

Author: Elena Bratkovskaya[1]

[1] *FIAS*

Corresponding Author: elena.bratkovskaya@th.physik.uni-frankfurt.de

We study the equilibrium properties of strongly-interacting infinite parton-hadron matter and the non-equilibrium dynamics of heavy-ion collisions from SIS to LHC energies within the Parton-Hadron-String Dynamics (PHSD) transport approach, which incorporates explicit partonic degrees of freedom in terms of strongly interacting quasiparticles (quarks and gluons) in line with an equation of state from lattice QCD as well as the dynamical hadronization and hadronic collision dynamics in the final reaction phase.

The equilibration of different observables on light and strange sector and their fluctuations in the QGP and also transport coefficients, such as shear and bulk viscosity, electric and heat conductivity are presented.

We investigate as well as out-off equilibrium phenomena seen in azimuthal angular distribution in higher harmonics (v1,v2,v3,v4), particle spectra etc. in heavy-ion collisions. We focus on the sensitivity of different observables (in particular, involving strange particles) to the "traces" of the QGP from low to ultrarelativistic energies.

Low Energy / Heavy Flavour / 67

The Production of K0's in p+p Reactions

Authors: Jia-Chii Berger-Chen[1]; Laura Fabbietti[2]

[1] *Technische Universitaet Muenchen (DE)*

[2] *Technische Universität München*

Since the recent discovery of a massive neutron star of about 1.97 solar masses [1] the discussion about a possible existence of a condensed kaon matter inside the neutron star has been revived [2,3]. Kaons not only influence the nuclear EOS [1,2], but also play an important role for the cooling process of a neutron star [4]. Thus a better understanding of the kaon nucleon/nucleus interaction is urgently requested. For example, characteristics of the interaction such as the KN potential and the KN scattering in medium still need further investigation.
These properties can be obtained by comparisons of proton-nucleus or heavy ion data to transport models [5,6,7]. Hence the models should be able to reproduce elementary reactions at the first place. In this contribution we present high statistics K0s data from p+p collisions at Ekin = 3.5 GeV measured by the HADES detector at GSI (Darmstadt, Germany). The measurement of this energy regime is of particular importance because of two reasons. First of all there is a lack of data at these energies.

Second of all it is not clear, whether the processes are dominated by resonance productions or already need to be described via string models (e.g. PYTHIA or FRITIOF) in the transport calculations. In both cases the constraints put up by this measurement for the transport models will be essential for the interpretation of the physics measured by CBM at the future FAIR facility.
The good statistics in the p+p data set allow for a double differential analysis in pt-y and angular distributions in momentum bins. Exclusive production channels as p + p -> Y + Delta++ + K0, p + p -> Y + p + pi+ + K0 and others have been studied and the extraction of the relative cross sections has been carried out. In particular, the role played by the Delta++ resonance has been adressed. These results can be used to constrain the transport models. Results of the ongoing investigation and the influence of angular anisotropy will be presented in the contribution.

[1] P.B. Demorest et al., Nature 467, 10811083 (2010);
[2] K. Masuda et al., arXiv:1205.3621[nucl-th] (2012);
[3] K. Kim et al., Phys. Rev. C 84, 035810 (2011);
[4] S. Kubis et al., Nucl. Phys. A, 720 189-206 (2003);
[5] G. Agakishiev et al., Phys. Rev. C 82, 044907 (2010);
[6] M. B¨uscher et al., Eur. Phys. J. A 22, 301-317 (2004);
[7] M.L. Benabderrahmane et al., PRL 102, 182501 (2009).

Strangeness 1 / 29

Kaon femtoscopy in 200 GeV central Au+Au collsions at STAR

Author: Robert Vertesi[1]

[1] *Nuclear Physics Institute of the Czech Academy of Sciences*

Corresponding Author: vertesi.robert@wigner.mta.hu

Three-dimensional source extraction techniques allow us to get an
insight to the space-time extent and the freezeout dynamics of the hot and dense medium created in RHIC high energy heavy ion collisions, using Bose-Einstein correlated like-sign hadron pairs. Three-dimensional analyses of the pion source revealed a heavy, non-Gaussian tail in the "out" direction. The interpretation of these pion sources in terms of pure hydrodynamical evolution is, however, complicated by the strong contribution of feed-down from long-lived resonances to the source. On the other hand, kaons provide a much cleaner probe of the expanding fireball.

We present a recent three-dimensional kaon correlation analysis in
central Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV, using
Cartesian harmonics decomposition technique. We compare the three-dimensional spatial source function of kaons to that of pions, and
to a thermal model of source evolution. We also present results on the three-dimensional extent of the kaon source with respect to the pair transverse momentum, and compare it to predictions of two different hydrodynamical models.

Flow / 117

Effects of Jets in the Flow Observables

Author: Jun Takahashi[1]

Co-author: Rafael Derradi de Souza [1]

[1] *UNICAMP*

Corresponding Author: jun@ifi.unicamp.br

The study of the transverse momentum anisotropy of the particles produced in heavy ion collisions is one of the most important experimental observable to investigate the collective behavior of the systems created in such collisions. Recent studies show that the complexity of the nature of the system evolution, such as initial condition fluctuations and jets, may lead to important effects in the flow coefficients and, therefore, to misinterpretation of the results obtained. In this study, we used combined simulated events produced with a hydrodynamic model which allows inhomogeneous initial condition and proton-proton collisions produced with Pythia event generator to create a final set of particles to be analyzed with the usual experimental flow calculation techniques. Although this modest approach is somehow unrealistic, since it does not include the interaction of the jet with the medium, our results have shown a good agreement of the behavior of the elliptic flow coefficient as a function of the transverse momentum up to 6 GeV/c for Au+Au collisions at 200 GeV. Despite each model alone is not able to describe the full range, the combination of both set of particles as seem by the flow calculation techniques may be the key to explain the behavior observed in experimental data.

Flow / 126

Landau hydrodynamics for non-central heavy-ion collisions and longitudinal scaling of elliptic flow

Author: Karolis Tamosiunas[1]

[1] *Vilnius University (LT)*

Corresponding Author: karolis.tamosiunas@cern.ch

Landau solution of hydrodynamics is generalized for the non-central high-energy nuclear collisions. The multiparticle production after hydrodynamic expansion from the transversely asymmetric initial state shows elliptic flow formation.
Moreover, obtained solution does reproduce the observed longitudinal scaling of the elliptic flow for the different collision energies at LHC and RHIC. It will be argued, that the analyticity of the solution allows us to separate collective pressure driven flow effects from the initial conditions.

Strangeness 1 / 73

Study of h-h and V0-h angular correlations in Pb-Pb collisions at sNN = 2.76 TeV

Author: Marek Bombara[1]

[1] *Pavol Jozef Safarik University (SK)*

Corresponding Author: marek.bombara@cern.ch

Two-particle angular correlations provide a powerful tool to study jets and their modication in ultra-relativistic heavy-ion collisions. The study of the particle species dependence of correlation structures as a function of transverse momentum provides additional information on the particle production mechanisms at LHC energies.
In this contribution we will present studies of a near-side jet-like correlation peak in (eta,phi) space for Pb-Pb collisions at
sqrt(s_NN) = 2.76 TeV. The measurement is performed using the correlations formed by pairs of high pT (6 < pT_trig < 15 GeV/c) , and Lambda, antiLambda, K0S (trigger particles) associated with unidentified charged hadrons in the transverse momentum range 3 GeV/c < pT_assoc < pT_trig. The jet-like peak yield and width for different trigger strange particles are investigated as a function of pT_trig, pT_assoc and collision centrality.

Low Energy / Heavy Flavour / 5

Effect of quark gluon plasma on charm quark produced in relativistic heavy ion collision

Author: Mohammed Younus[1]

Co-author: Dinesh Srivastava [2]

[1] *Variable Energy Cyclotron Centre*

[2] *Variable Energy Cyclotron Centre, Kolkata*

Corresponding Author: younus.presi@gmail.com

Charm quarks are produced mainly in the pre-equilibrium stage of heavy ion collision and serve as excellent probes entering the thermalized medium medium. They come out with altogether different momentum and energies and fragments into D mesons and later decay into non-photonic electron which are experimentally observed. Here we present effects of Quark Gluon Plasma on charm quark production using two different models, one of which is the calculations based on Wang-Huang-Sarcevic model of multiple collisions and other using the calculations of Parton Cascade Model based on Microscopic Boltzmann Transport Equation.

Summary:

The results from the model studies are compared with experimental data available at RHIC and LHC. The results are also compared with theoretical models from other literatures.

Strangeness 1 / 32

Multiplicity fluctuations of identified hadrons in p+p interactions at SPS energies

Author: Andrzej Gabriel Wilczek[1]

[1] *University of Silesia (PL)*

Corresponding Author: andrzej.wilczek@cern.ch

The problem of pinning down the critical point of strongly interacting matter still puzzles the community. One of the answers suspected to emerge in the near future will surely come from NA61/SHINE - a fixed-target experiment aiming to discover the critical point as well as to study the properties of the onset of deconfinement.

This goal will be reached by obtaining precise data on hadron production in proton-proton, proton-nucleus and nucleus-nucleus interactions in a wide range of system size and collision energy.

In this contribution inclusive spectra of identified hadrons in p+p interactions at the SPS energies will be shown as a function of transverse momentum/mass and rapidity. New data will be compared with the corresponding results of NA49 for central Pb+Pb collisions as well as with some model predictions.

Low Energy / Heavy Flavour / 104

Gluon radiation by heavy quarks

Author: Thierry Gousset[1]

[1] *Subatech*

Corresponding Author: gousset@subatech.in2p3.fr

It is generally assumed that in ultrarelativistic heavy ion collisions a plasma of quarks and gluons is produced, and then quickly expands and hadronizes. The main objective of present experiments at ultrarelativistic heavy ion colliders is to study this plasma. The study of the plasma properties is difficult because the initial momentum distribution of the light quarks is not known and that before being detected the system passes the chiral/confinement phase transition in which hadrons are formed. Hadrons interact on the way to the detectors what modifies their spectrum. Therefore soft light hadrons do not carry information on the early stage of the plasma.

The situation is much better for heavy quarks (c and b) which are created in hard processes. Here 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 developped [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. 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. 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. The latter has the advantage of leading to very compact expressions for the various integrated cross sections and also of making more transparent the discussion of various physical phenomena. We discuss in particular the relevance of the dead cone effect.

[1] P.B. Gossiaux and J. Aichelin, Phys Rev C78, 014904 (2008)

Flow / **63**

Charge asymmetry dependency of {π}/K anisotropic flow in U+U {$\sqrt{s_{NN}}$} = 193 GeV and Au+Au {$\sqrt{s_{NN}}$} = 200 GeV collisions at STAR

Author: Qi-Ye Shou[1]

[1] *SINAP, BNL*

Corresponding Author: qyshou@rcf.rhic.bnl.gov

Theoretical study\cite{myref1} indicates that a chiral magnetic wave at finite baryon density could induce an electric quadrupole moment in QGP produced in heavy-ion collisions. The electric quadrupole deformation will lead to a difference in elliptic flow of hadrons, by increasing $\{v_2\}$ of negatively charged hadrons and decreasing $\{v_2\}$ of positively charged ones. The magnitude of this difference is predicted to be proportional to the charge asymmetry $\{A_{ch}\}$, defined as $\{A_{ch} \equiv \left(\bar{N}_+ - \bar{N}_-\right) / \left(\bar{N}_+ + \bar{N}_-\right)\}$. Such charge asymmetry dependency of pion elliptic flow has been observed in Au+Au collisions at the STAR experiment. \\

\newline

Here we present elliptic flow measurements of charged pions and kaons at low momentum, as a function of $\{A_{ch}\}$, in U+U collisions at $\{\sqrt{s_{NN}}\}$ = 193 GeV at STAR. The $\{v_2\}$ difference for charged kaons is suggested\cite{myref1} to have a weaker $\{A_{ch}\}$ dependency than that of pions due to hadronic effects. Our measurements for both serve as important consistency checks for the phenomena due to the chiral magnetic wave.

Polarisation observables and eA / 10

Turbulence, Vorticity and Lambda Polarization

Author: Laszlo Pal Csernai[None]

Co-authors: Du-Juan Wang [1]; Francesco Becattini [2]

[1] *University of Bergen*

[2] *Unversity of Florence*

Corresponding Author: laszlo@csernai.no

Due to the low viscosity and strongly interacting QGP at high LHC energies flow fluctuations were observed up to the 8th flow harmonics. Similarly rotation, turbulence and even Kelvin-Helmholtz Instability were predicted and these may be observable by different methods. Apart of the usual flow harmonics analysis, other methods like two particle correlations, or particle polarizations may arise as a consequence of these processes. The appearance of turbulent phenomena in these experiments would be additional direct proof of the low viscosity.

In particular we observed in 3+1D fluid dynamical calculations at LHC energy that Lambda polarization arising from thermal and mechanical equilibrium, can provide measurable signal in given azimuthal directions. This mechanism is considerably stronger than the polarization arising from the direct electro-magnetic effect of the strong and rapidly changing fields during the collision.

Summary:

The talk is based on the following publications:
L.P. Csernai, V.K. Magas, H. Stoecker, and D.D. Strottman, Phys. Rev. C 84, 024914 (2011).
L.P.Csernai, D.D.Strottman, Cs.Anderlik, Phys.Rev.C 85, 054901 (2012).
L.P. Csernai, V.K. Magas, D. J. Wang, Phys. Rev. C 87, 034906 (2013).
F. Becattini, V. Chandra, L. Del Zanna, and E. Grossi, arXiv:1303.3431

Phase Transition / 15

An Inverse Magnetic Catalysis Effect Induced by Sphalerons

Author: Jingyi Chao[1]

Co-author: Mei Huang [2]

[1] *Institute of High Energy Physics, CAS*

[2] *IHEP, CAS*

Corresponding Author: jychao@impcas.ac.cn

We find that the barrier between topologically in-equivalent vacua is lowered at the presence of external magnetic field. As a consequence, the imbalanced chiral quark density arises due to the sphaleron transition at finite temperatures. It quantitatively explains and describes the unusual phenomena of the inverse magnetic catalysis, which was numerically found to happen at the transition between the hadron, low-temperature phase and hot, magnetized quark-gluon plasma. We also propose revelant singantures of this effect to be experimentally accessible in the magnetised plasma environment created in noncentral heavy-ion collisions at the LHC.

Heavy Flavour 1 / 49

Nuclear Modification Factor and Elliptic Flow of Muons from Heavy-Flavour Hadron Decays in Pb–Pb Collisions at √ sNN = 2.76 TeV with ALICE

Authors: Xiaoming Zhang[1]; Xiaoming Zhang[1]

[1] *Lawrence Berkeley National Lab. (US)*

Corresponding Authors: zhangxm@iopp.ccnu.edu.cn, xiaoming.zhang@cern.ch

Nuclear Modification Factor and Elliptic Flow of Muons from Heavy-Flavour Hadron Decays in Pb–Pb Collisions at √ sNN = 2.76 TeV with ALICE

X. Zhang for the ALICE Collaboration
Lawrence Berkeley National Laboratory, Berkeley, CA, U. S. A.

The LHC heavy-ion physics program aims at investigating the properties of strongly-interacting matter in 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 efficient probes of the properties of the QGP as they are created on a very short time scale in initial hard scattering processes and subsequently interact with the medium.

In the high transverse momentum region, the suppression of the
heavy-flavour production, quantified by means of 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 heavy quark in-medium energy loss mechanisms. The heavy-flavour elliptic flow, the second order coefficient of the Fourier expansion of particle azimuthal distributions, provides insights on the degree of thermalization of heavy quarks in the deconfined medium and carries information on the path length dependence of parton energy loss in the low and high transverse momentum region, respectively.

ALICE, the only detector designed and optimized for heavy-ion physics at the LHC, measures open-heavy flavours at forward rapidity ($2.5 < y < 4$) using semi-muonic decays. The latest results on the nuclear modification factor and elliptic flow of muons from heavy-flavour decays in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$˜TeV will be presented.

Heavy Flavour 1 / 109

Heavy Quark Energy Loss and Bulk Physics

Author: W A Horowitz[1]

[1] *University of Cape Town*

Corresponding Author: wa.horowitz@gmail.com

Bulk matter phenomena in heavy ion collisions is characterized by an extremely small viscosity to entropy ratio best understood by strong coupling dynamics described by the AdS/CFT correspondence. We test a consistent description of QGP physics by applying this AdS/CFT paradigm to the energy loss of heavy quarks. Previously we found consistency with the non-photonic electron data at RHIC but a significant, systematic oversuppression compared to LHC D meson measurements; b quark energy loss is so far consistent within the large uncertainties of current LHC results. Previous predictions for light mesons are also suggestive of oversuppression in this AdS/CFT picture. We present an attempt to resolve the discrepancy between the AdS/CFT energy loss predictions and data by incorporating a more realistic matching between the AdS/CFT world and ours, and thus resolve the current contradiction between the low momentum and high momentum physics phenomena seen at RHIC and LHC.

Phase Transition / 113

Flavor-specific behavior of conserved charge fluctuations at the QCD confinement transition

Author: Marcus Bluhm[1]

[1] *SUBATECH Nantes*

Great experimental and theoretical effort is being put into the detailed study of the confinement/deconfinement transition in QCD matter. Susceptibilities of conserved quantities, which are related to the statistical moments of particle multiplicity distributions measured in heavy-ion collisions, provide important insight, in particular, into the composition of the produced matter. Based on a study of the higher moments of quark-flavor quantum number distributions, I will argue in this talk about a potential hierarchy in the hadronization sequence of different quark flavors during the course of an ultra-relativistic heavy-ion collision. Such a flavor-dependence would, in particular, influence the production of strange versus non-strange (light-quark) hadrons in comparison with standard approaches which assume a flavor-independent hadronization. The presented study will rest upon an interplay between recent lattice QCD results for the quark-number susceptibilities of different quark flavors, recent measurements of particle multiplicity distributions from the ALICE collaboration and phenomenological models that aim to relate the thermal properties of the QCD matter at the confinement/deconfinement transition to final state hadron measurements.

Polarisation observables and eA / 83

Relativistic distribution function for particles with spin at local thermodynamical equilibrium

Authors: Eduardo Grossi[1]; Francesco Becattini[2]

Co-authors: Luca Del Zanna [3]; Vinod Chandra [4]

[1] *University of Florence & INFN Florence*

[2] *Unversity of Florence*

[3] *University of Florence*

[4] *INFN Florence, Italy*

Corresponding Author: grossi@fi.infn.it

We present an extension of relativistic single-particle distribution function for weakly interacting particles at local thermodynamical equilibrium including spin degrees of freedom, for massive spin 1/2 particles. We infer, on the basis of the global equilibrium case, that at local thermodynamical equilibrium particles acquire a net polarization proportional to the vorticity of the inverse temperature four-vector field. The obtained formula for polarization also implies that a steady gradient of temperature entails a polarization orthogonal to particle momentum. The single-particle distribution function in momentum space extends the so-called Cooper-Frye formula to particles with spin 1/2 and allows to predict their polarization, and particularly of Lambda hyperons, in relativistic heavy ion collisions at the freeze-out.

Polarisation observables and eA / 102

Hyperon Polarization in Heavy ion Collisions

Author: Celso Barros[1]

[1] *Universidade Federal de Santa Catarina*

Corresponding Author: barros@fsc.ufsc.br

The STAR collaboration has measured the Λ and anti-Λ polarizations in 200 GeV Au-Au collisions [1]. These results can be understood in terms of a model [2], [3], that we proposed recently, based on the hydrodynamical model, and taking into account the effect of the final-state interactions (that occur in the hadronic phase) between the hyperons and other produced particles. These final interactions are described in terms of chiral effective lagrangians, that consider many hadronic processes. This model describes quite well the antihyperon polarization data obtained in proton-nucleus collisions, and now we extended it to study nucleus-nucleus collisions, with a very good accord. Theoretical results obtained with other models will also be discussed. The perspectives of hyperon and antihyperon polarization at LHC is another subject of interest.

References:

[1] STAR Collaboration: B. I. Abelev et al., Phys. Rev. C, 76, (2007) 024915.
[2] C. C. Barros Jr. and Y. Hama, Phys. Lett. B., 699, 74 (2011).
[3] C. C. Barros Jr., to be submitter soon.

Phase Transition / 24

Quark-hadron phase transition in a three flavor PNJL model

Author: Kanako Yamazaki[1]

Co-author: Tetsuo Matsui [2]

[1] *University of Tokyo*

[2] *Institute of Physics, University of Tokyo*

We extend our previous study of the quark-hadron phase transition at finite temperatures with zero net baryon density by two flavor Nambu-Jona-Lasinio model with Polyakov loop [1] to the three flavor case. At low temperatures, only mesonic correlations,

mainly due to mesonic collective excitations, dominate the pressure
while thermal excitations of quarks are suppressed by the Polyakov loop.
As temperature increases, mesonic collective modes melt into
the continuum of quark and anti-quark so that hadronic phase changes
continuously to the quark phase where quark excitations dominate pressure. We add
the gluon pressure in a phenomenological way through the effective
potential for the Polyakov loop. Since we introduce mesons as not elementary fields but
auxiliary fields made from quarks, we can describe the phase transition
between hadronic phase and quark phase in a unified fashion.

[1] Kanako Yamazaki and T.Matsui, arXiv:1212.6165 [hep-ph].

Heavy Flavour 1 / 112

Heavy-flavor azimuthal correlations of D mesons

Author: Marlene Nahrgang[None]

Co-authors: Joerg Aichelin [1]; Klaus Werner [2]

[1] *Unknown*

[2] *SUBATECH*

Corresponding Author: nahrgang@th.physik.uni-frankfurt.de

The observation of strong jet quenching and the suppression of high-p_t hadrons in relativistic heavy-ion collisions are striking experimental signatures for the formation of a deconfined QCD plasma in which partons suffer from in-medium energy loss. In particular, heavy quarks are considered as suitable probes for revealing the properties of the produced matter as they are created at very early stages in hard scattering processes and assumed not to thermalize completely within the medium. Typical observables for the interaction of heavy quarks with the medium constituents are the nuclear modification factor R_{AA} and the elliptic flow v_2, which we present within a combined Monte-Carlo approach and realistic fluid dynamic description of the expanding plasma for both RHIC and LHC energies. In the main part of this talk we will investigate the potential of correlations between heavy quarks and anti-quarks to reveal basic principles of energy loss scenarios at LHC. At low p_t any correlation of the initially heavy quark-antiquark pair is lost due to thermalization, at larger p_t, however, these correlations in p_t and azimuthal angle ϕ survive and show distinctive features for purely elastic and elastic plus radiative energy loss mechanisms. We discuss these results in view of the centrality dependence, next-to-leading order production processes and details of the equation of state.

Phase Transition / 35

Transport coefficients from the Nambu-Jona-Lasinio model for SU(3)f

Author: Rudy Marty[1]

Co-authors: Elena Bratkovskaya [2]; Joerg Aichelin [3]; Wolfgang Cassing [4]

[1] *FIAS (Frankfurt, GERMANY)*

[2] *FIAS*

[3] *Unknown*

[4] *University of Giessen*

Corresponding Author: marty@fias.uni-frankfurt.de

Based on the Nambu-Jona-Lasinio model for 3 flavours we study the transport properties of strongly interacting matter in vicinity of the phase transition. We present our results on the temperature dependence of the shear and bulk viscosity (calculated within the relaxation time formalism), as well as of the electric and heat conductivity.

We compare these results with recent lattice data and the transport coefficients of the DQPM (dynamical quasiparticle model). These transport coefficients allow for discussing quantitatively how fast particles traverse the quark gluon plasma and open the possibility to compare different approaches for the expansion of the quark gluon plasma created in ultrarelativistic heavy ion collisions.

Polarisation observables and eA / 86

eRHIC: A Precision Tool for Studying Nuclear Structure.

Author: Thomas Burton[1]

[1] *BNL*

Corresponding Author: tpb@bnl.gov

eRHIC is envisaged as a next-generation upgrade to the RHIC facility, involving the addition of a high-intensity, high-energy electron beam, to deliver a broad programme of both nuclear and spin physics.
e+A collisions at eRHIC will answer open questions about the distribution and interactions of gluons within nuclei, something not possible with any existing machine. They will allow precise probing of the nuclear initial state, due to both the absence of the final-state interactions present in nucleus-nucleus collisions, which obscure details of the initial state, and the precise reconstruction of the initial event kinematics afforded by an electron beam. Exclusive diffractive collisions will allow the nuclear gluon distribution to be imaged in detail, while the use of nuclear beams will provide access to the regime of low-x gluon saturation, for which there are presently only tantalising hints. Meanwhile, polarised electron and proton beams will yield unmatched detail in characterising the spin structure of nucleons. I will summarise the features of the eRHIC accelerator itself and some of the key measurements to be made, with a focus on in its e+A physics programme.

Heavy Flavour 1 / 28

Heavy Flavour Suppression: Boltzmann vs Langevin

Author: Santosh Kumar Das[1]

Co-authors: Francesco Scardina [2]; Vincenzo Greco [3]

[1] *Department of Physics and Astrophysics, University of Catania*

[2] *Department of Physics and Astronomy, University of Catania*

[3] *department of Physics and Astronomy, University of Catania*

Corresponding Author: santosh@lns.infn.it

The propagation of heavy flavour through the quark gluon plasma has been treated commonly within the framework of Langevin dynamics,
i.e. assuming the heavy flavour momentum transfer is much smaller than the light one. On the other hand a similar suppression factor R_AA has been observed experimentally for light and heavy flavor.
We present a thorough study of the thermalization dynamics and of the approximations involved by Langevin equation by mean of a direct comparison with the full collisional integral within the

framework of Boltzmann transport equation. We found that it is difficult to achieve thermalization in Langevin dynamics for a realistic momentum dependence of the drag and diffusion coefficients. The nuclear suppression factor, R_{AA} and the elliptic flow v_2^{HF} of the charm and bottom quarks have been evaluated at RHIC and LHC energies within both the Langevin and Boltzmann approach. We have compared the results obtained in both approaches which can differ substantially leading to quite different values extracted for the the heavy quark diffusion coefficient.

Polarisation observables and eA / 140

LHeC

Author: Paul Richard Newman[1]

[1] *University of Birmingham (GB)*

Corresponding Author: paul.richard.newman@cern.ch

Heavy Flavour 1 / 31

Shear viscosity of a multi-component hadronic system

Author: Anton Wiranata[1]

Co-authors: Madappa Prakash [2]; Volker Koch [3]; Xin-Nian Wang [4]

[1] *Lawrence Berkeley Lab*

[2] *Ohio University*

[3] *LBNL*

[4] *Lawrence Berkeley National Lab. (US)*

Corresponding Author: awiranata@lbl.gov

Shear viscosity η and entropy density s of a hadronic resonance gas are calculated consistently within the Chapman-Enskog
approximation using the K-matrix parameterization of hadronic cross sections which preserves the unitarity of the T-matrix. In the $\pi - K - N - \eta$ mixture considered, a total of 82 resonances up to 2 GeV were included. Comparisons are also made to results with other hadronic cross sections such as the Breit-Wigner (BW) and, where available, experimental phase shift (EXP) parameterizations. The BW parameterization fails to preserve unitarity of the $T-$matrix for nearby resonances, whereas experimental phase shifts are not available for all resonances considered. Hadronic interactions among the many resonances are shown to decrease the shear viscosity and increase the entropy density leading to a reduction of η/s as the QCD phase transition temperature is approached.

Phase Transition / 27

Diffusion of non-Gaussianity in heavy ion collisions

Author: Masakiyo Kitazawa[1]

Co-author: Masayuki Asakawa [1]

[1] *Osaka University*

Corresponding Author: kitazawa@phys.sci.osaka-u.ac.jp

We investigate time evolution of higher-order cumulants of bulk fluctuations of conserved charges in the hadronic stage in heavy ion collisions.
The dynamical evolution of the non-Gaussian fluctuations are modeled by the diffusion master equation. In this model, we show that the fourth-order cumulant is suppressed compared with the recently observed second-order one at ALICE.
Significance of various cumulants as functions of rapidity acceptance as experimental observables to probe dynamical history of fireballs are emphasized.

Plenary 6 / 155

Strange Quark Matter (Astro)

Corresponding Author: alford@physics.wustl.edu

Plenary 6 / 156

Traveling Through the Universe: Back in Time to the Quark-Gluon Plasma Era

Corresponding Author: jrafelski@yahoo.com

Plenary 6 / 115

Quark-gluon plasma phenomenology from the lattice

Author: Chris Allton[1]

Co-authors: Jon-Ivar Skullerud [2]; Wynne Evans [1]

[1] *Swansea University*

[2] *National University of Ireland Maynooth*

Corresponding Author: c.allton@swan.ac.uk

The interquark potential in charmonium states is calculated for the first time in both the zero and non-zero temperature phases from a first-principles lattice QCD calculation. Simulations with two dynamical quark flavours were used with temperatures T in the range 0.4Tc ⊠ T ⊠ 1.7Tc, where Tc is the deconfining temperature. The correlators of point-split operators were analysed to gain spatial information about the charmonium states. A method, introduced by the HAL QCD collaboration and based on the Schr¨odinger equation, was applied to obtain the interquark potential. We find a clear temperature dependence, with the central potential becoming flatter (more screened) as the temperature increases.

Plenary 7 / 134

Role of fluctuations in detecting the QCD phase transition

Author: Krzysztof Redlich[1]

[1] *University of Wroclaw (PL)*

Corresponding Author: krzysztof.redlich@cern.ch

We will discuss the role of fluctuations of conserved charges and the Polayakov loop, as well as their probability distributions, to detect deconfinement and chiral phase transition or their remnants.

Plenary 7 / 137

Holographic descriptions of dense quark matter

Author: Prem Kumar[1]

[1] *Swansea University*

Corresponding Author: s.p.kumar@swansea.ac.uk

The properties of quark matter at high density and strong coupling remain largely intractable using conventional tools. We review how the tools of string theory and holography can pave the way towards a better understanding of general properties of such phases of matter using a holographically dual gravitational picture. We will describe some recent results within such a framework that point at novel critical scaling behaviour emerging as long-wavelength descriptions of high density systems.

Plenary 7 / 135

Coarse Graining in Hydrodynamics and Effects of Fluctuations

Authors: Takeshi Kodama[1]; Takeshi Kodama[2]

[1] *Universidade Federal do Rio de Janeiro*

[2] *F*

Corresponding Authors: tkodama@if.ufrj.br, kodama@fias.uni-frankfurt.de

The success of hydrodynamic description of the collective flow dynamics in relativistic heavy ion collisions is often understood as the realization of local thermal equilibrium during the phase of QGP. However, the scale of locality is not clear. Some of such basic questions about the hydrodynamic approach to relativistic heavy-ion collisions are discussed aiming to clarify how far we can go with such an approach to extract useful information on the properties and dynamics of the QCD matter created. We emphasize the importance of the coarse graining scale required for the hydrodynamic modeling which determines the space-time resolution and the associated limitations of collective flow observables. We show that certain kinds of observables can indicate the degree of non homogeneity of the initial condition under less stringent condition than the local thermal equilibrium subjected to the coarse-graining scale compatible to the scenario. The origin of viscosity associated with the coarse-graining procedure is also discussed.

Summary:

Importance of coarse-graining scale related with the type of observables is discussed.

Plenary 8 / **44**

Hydrodynamic models of particle production - p-Pb collisions

Author: Piotr Bozek[None]

The modelling of the collective expansion in A-A and p-A collisions and the role of initial conditions for the fireball are discussed. Predictions for spectra of strange baryons and mesons are presented. Di-hadron correlations between identified particles, resulting from flow and charge correlations are estimated in the model.

Plenary 8 / **91**

Interpretation of strange hadron production at LHC

Author: Michal Petran[1]

Co-authors: Jean Letessier [2]; Johann Rafelski [3]; Vojtech Petracek [1]

[1] *Czech Technical University (CZ)*

[2] *Laboratoire de Physique Theorique et Hautes Energies, Universite Paris 6, Paris 75005, France*

[3] *University of Arizona*

Corresponding Author: michal.petran@cern.ch

We present a highly successful description of all available particle yields in Pb–Pb collisions at 2.76 TeV measured by the ALICE experiment as a function of centrality. We find that our fit of π, K, p, Ξ and Ω within the framework of non–equilibrium statistical hadronization model is consistent with previous fits of Au–Au data at 62.4 and 200 GeV from RHIC. The more precise LHC data strongly support chemical non-equilibrium model and chemical freeze-out temperature of T ⊠ 140 MeV. The high entropy content of the fireball suggests additional entropy production mechanism increasing with centrality, yet to be understood. Strangeness content of the fireball shows saturation already for small systems at LHC energy suggesting a chemically equilibrated QGP as a source of hadrons. Our results show universal hadronization conditions of the particle source, represented by critical pressure P ⊠ 80 MeV/fm3 , energy density ε ⊠ 0.5 GeV/fm3 and entropy density σ ⊠ 3.3 fm-3. These conditions apply to both RHIC and LHC for all collision centralities, in which the fit procedure works.

Plenary 8 / **157**

Confronting LHC data with the statistical hadronization model

Corresponding Author: stachel@physi.uni-heidelberg.de

Plenary 9 / **78**

Latest LHCb results from the pA data

Authors: Liang Zhong[1]; Marta Calvi[2]

[1] *Tsinghua University (CN)*

[2] *Universita & INFN, Milano-Bicocca (IT)*

Corresponding Authors: liang.zhong@cern.ch, marta.calvi@mib.infn.it

With a unique forward acceptance, and excellent vertexing and particle identification capability, LHCb is well-placed to make important contributions to heavy ion physics through measurements performed using data taken during pA and Ap collisions. The first studies of these data will be presented. These include measurements of particle multiplicity and studies of strange and charmed particle and onia production.

Plenary 9 / 158

p-Pb Results from ALICE with an Emphasis on Centrality Determination

Corresponding Author: andreas.morsch@cern.ch

Plenary 9 / 92

Identified hadron production in pp and pPb collisions with CMS

Authors: Eric Andrew Appelt[1]; The CMS Collaboration[2]

[1] *Vanderbilt University (US)*

[2] *CMS*

Corresponding Authors: eric.andrew.appelt@cern.ch, sergeant@mail.cern.ch

Spectra of identified charged hadrons measured in pPb collisions at the LHC at $sqrts_{NN} = 5$TeV are presented. Charged pions, kaons, and protons in the transverse-momentum range p_T = 0.1-1.7 GeV/c and for central rapidities are identified via their energy loss in the CMS silicon tracker. The average p_T increases rapidly with the mass of the hadron and the charged-particle multiplicity of the event. The fully corrected transverse momentum spectra and integrated yields are compared to pp data at various collision energies and to several Monte Carlo event generators.

Heavy Flavour 2 / 16

Towards the dynamical study of heavy-flavour quarks in the Quark-Gluon-Plasma

Author: Hamza Berrehrah[1]

Co-authors: Elena Bratkovskaya [1]; Joerg Aichelin [2]; Pol Gossiaux [3]; Wolfgang Cassing [4]

[1] *FIAS*

[2] *Unknown*

[3] *Subatech*

[4] *University of Giessen*

Corresponding Author: berrehrah@fias.uni-frankfurt.de

The aim of this project is to study the properties of the QGP produced in relativistic heavy-ion collisions (HIC) using heavy quarks - charm and beauty (c, b) - as penetrating probes. The heavy quarks (and correspondingly charm and beauty mesons) are considered to be one of the best probes for such a study since due to their large mass they are produced dominantly by hard processes during the early stage of the reaction when the QCP is formed; traversing the plasma they do not come into equilibrium with the environment since their interaction with the partons is probably not strong enough.

Our study of charm dynamics in HIC is based on the existing microscopic PHSD (Parton-Hadron-String Dynamics) transport approach [1] which incorporates explicit partonic degrees-of-freedom in terms of strongly interacting quasiparticles (quarks and gluons) in line with an equation-of-state from lattice QCD as well as the dynamical hadronization and hadronic collision dynamics in the final reaction phase.
The evaluation of scattering cross sections of heavy quarks with the QGP quasiparticles represents the first step of this study.

In our contribution, we will present the elastic scattering cross section of heavy quarks with partons in vacuum and in the QGP medium [2] at finite temperature and chemical potential. We will, furthermore, present our evaluation of the transport coefficients, employing this cross section and discuss the dynamical collisional energy loss of heavy quarks in the QGP. Our results show clearly the effect of finite temperature and chemical potential on the perturbative heavy quark cross section, transport coefficients and collisional energy loss [2, 3].

[1] W. Cassing, and E. L. Bratkovskaya, "Parton-Hadron-String Dynamics: an off-shell transport approach for relativistic energies", Nucl. Phys. A831 (2009) 215-242.
[2] H. Berrehrah, P.B. Gossiaux, J. Aichelin, E. Bratkovskaya, W. Cassing and M. Bleicher, "Collisional processes of heavy quarks in vacuum and in the QGP medium", in preparation.
[3] H. Berrehrah, E. Bratkovskaya, W. Cassing, P.B. Gossiaux and J. Aichelin, "Interaction rates, dynamical collisional energy loss and transport coefficients of heavy quarks in vacuum and in the QGP medium", in preparation.

Beam Energy Scan / 25

The QCD phase transition in a fully dynamical model of heavy-ion collisions

Author: Christoph Herold[1]

Co-authors: Igor Mishustin [1]; Marcus Bleicher [2]; Marlene Nahrgang [3]

[1] *Frankfurt Institute for Advanced Studies*

[2] *Uni Frankfurt*

[3] *Duke University*

Experimental signals for a possible QCD critial point and first-order phase transition are strongly influenced by the rapid nonequilibrium dynamics during a heavy-ion collision. In order to estimate and understand these effects we study the cooling through the phase transition within a nonequilibrium chiral fluid dynamics model. The order parameters for the chiral and deconfinement transition are explicitly propagated, taking into account dissipation and fluctuation stemming from the interaction with a quark-antiquark fluid. In studies of single events, we demonstrate for the first time in a realistic dynamical study the formation of domains in net-baryon density at the first-order transition. This shows that nonequilibrium effects are strong enough to favor spinodal decomposition. As a possible experimental signal we find a clear enhancement of higher flow harmonics. For the detection of the critical point it is crucial that the relevant signal survives the rapid dynamics. Critical

slowing down is manifestly incorporated in our model and influences the growth of the correlation length. We demonstrate in an event-by-event analysis that fluctuations of the volume-averaged order parameters develop a clear peak around the critical point in a dynamical system like a heavy-ion collision.

Hard Probes / 96

Electroweak boson production in heavy-ion collisions with CMS

Authors: Michael Gardner[1]; The CMS Collaboration[2]

[1] *University of California Davis (US)*

[2] *CMS*

Corresponding Authors: michael.david.gardner@cern.ch, sergeant@mail.cern.ch

The Compact Muon Solenoid (CMS) is fully equipped to measure leptonic decays of electroweak probes in the high multiplicity environment of nucleus-nucleus collisions. Electroweak boson production is an important benchmark process at hadron colliders. Precise measurements of W and Z production in heavy-ion collisions can help to constrain nuclear PDFs as well as serve as a standard candle of the initial state in PbPb collisions at the LHC energies. The inclusive and differential measurements of the Z boson yield in the muon decay channel will be presented, establishing that no modification is observed with respect to next-to-leading order pQCD calculations, scaled by the number of incoherent nucleon-nucleon collisions. Measurements of the yield of W bosons decaying into a muon and a(n anti)neutrino as a function of centrality, and the W charge asymmetry as a function of rapidity show no modifications beyond the expected effect of isospin when compared to pp collisions.

Hard Probes / 116

Jet production and structure in pp, p-Pb and Pb-Pb collisions measured by ALICE

Author: Collaboration ALICE[1]

[1] *CERN*

Corresponding Authors: marta.verweij@cern.ch, vercelli@to.infn.it

One of the major goals of jet and high pT measurements in heavy-ion collisions is the quantification of the medium-modified fragmentation of hard scattered partons. Here, the aim in the reconstruction of jets, as compared to single particle measurements, is to gain a larger sensitivity to the possibly modified structure of the parton shower. It aims at the understanding of the detailed mechanisms of in medium energy loss and their relation to transport properties of the medium itself.

The measurement of the jet production cross section in three different colliding systems pp (QCD vacuum), pPb (cold nuclear matter), and PbPb (hot partonic system) allows to extract the modification of jets in the hot and dense medium with respect to two references. Different angular resolutions (jet radii) allows for the a first estimate of the degree of angular modification in the medium.

In the context jets spectra and the measurement of a modified fragmentation compared to the vacuum reference it is important that the underlying event background and its fluctuations is treated consistently for all colliding systems.

We will present recent ALICE results on the jet production in pp, p-Pb and Pb-Pb collisions and discuss their sensitivity on a modified jet fragmentation process beyond a leading parton energy loss.

Heavy Flavour 2 / 39

Heavy vs. light flavor energy loss within a partonic transport model

Author: Jan Uphoff[1]

Co-authors: Carsten Greiner [2]; Oliver Fochler [3]; Zhe Xu [4]

[1] *Goethe University Frankfurt*

[2] *University of Frankfurt*

[3] *Goethe-Universität Frankfurt*

[4] *Tsinghua University Beijing*

Corresponding Author: uphoff@th.physik.uni-frankfurt.de

The full space-time evolution of gluons, light and heavy quarks 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, explicitly taking finite heavy quark masses into account. 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.

Beam Energy Scan / 85

Study of freeze-out dynamics in STAR at RHIC beam energy scan program

Author: Sabita Das[1]

[1] *Brookhaven National Laboratory, USA and Institute of Physics, India*

Corresponding Author: sabita@rcf.rhic.bnl.gov

The STAR experiment at RHIC has collected data at various collision energies in its beam energy scan (BES) program to study the QCD phase diagram. The BES program covers a large part of the QCD phase diagram in terms of temperature (T) versus baryon chemical potential (μ_B). The collected data set can be used to study the kinetic and chemical freeze-out dynamics. The kinetic and chemical freeze-out parameters can be extracted using the transverse momentum (p_T) spectra of hadrons and the total yields within the framework of statistical model assuming thermal equilibrium.

We report the centrality and energy dependence of chemical freeze-out parameters (temperature, baryon and strangeness chemical potential, and strangeness saturation factor) in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 11.5, 27, and 39 GeV. The chemical freeze-out conditions are obtained by comparing the experimentally measured ratios of particle yields at mid-rapidity, which includes $\pi^{\pm}$, $emphK^{\pm}$, $emphp$, $em\bar{p}hp$, K^0_S, Λ, $\bar{\Lambda}$, Ξ^-, and $\bar{\Xi}^+$ to those obtained from the statistical-thermal model calculations (THERMUS). The kinetic freeze-out parameters of temperature and radial collective flow are obtained by fitting the invariant pT differential yields of the produced hadrons, as a function of transverse momentum using a Blast Wave model.

Beam Energy Scan / 87

Beam energy scan using a viscous hydro+cascade model

Author: Iurii Karpenko[1]

Co-authors: Hannah Petersen ; Marcus Bleicher [2]; Pasi Huovinen [3]

[1] *Frankfurt Institute for Advanced Studies*

[2] *Uni Frankfurt*

[3] *Johann Wolfgang Goethe-Universität*

Corresponding Author: yu.karpenko@gmail.com

We employ the up-to-date version of viscous Hydro-Kinetic Model (vHKM) based on 3+1D viscous hydrodynamic code coupled to UrQMD hadron cascade.
Following the experimental program at BNL RHIC, we perform a similar "energy scan" in the model, and study the collision energy dependence of charged and identified hadron spectra, flow coefficients and femtoscopic radii. For this aim the equation of state for finite baryon density from Chiral model coupled to Polyakov loop is employed for hydrodynamic stage. 3D initial conditions from UrQMD model are used to study gradual deviation from boost-invariant picture for midrapidity interval justified for top RHIC energies and above.
In particular, we address the question, how far down in the collision energy the well-established at RHIC and LHC energies picture of (viscous) hydro+cascade can be applied at BES. Based on the constraints from the NA49/CERES data the model may also be used to provide the predictions for the measurements in RHIC BES program.

Heavy Flavour 2 / 118

Open charm measurements in $p + p$ collisions at STAR

Author: David Tlusty[1]

[1] *NPI ASCR*

Corresponding Author: tlusty@gmail.com

Heavy quarks are expected to be created from initial hard scatterings. Due to their large masses, their production can be described by perturbative QCD. The charm production cross section measurement in $p + p$ collisions provides an important baseline to further exploring the QCD medium. At STAR, charm quarks are measured through Open Charm Mesons and Non-photonic Electrons (electrons from semi-leptonic decays of charmed and bottom hadrons, NPE) production analysis.

In this talk, we will present the STAR results of open charm hadron and NPE productions at mid-rapidity in $p+p$ collisions at $\sqrt{s}$ = 200 and 500 GeV. Open charm mesons were reconstructed directly via hadronic decay channels with daughter particles identified by STAR Time Projection Chamber (TPC) and Time Of Flight (TOF) detectors and NPE yields were calculated by subtracting photonics electrons from inclusive electrons identified by TPC and Electromagnetic Calorimeter. These measurements are compared to theoretical model calculations and physics implications will be discussed.

Hard Probes / 105

Investigation of Mach cones and the corresponding two-particle correlations in a microscopic transport model

Author: Ioannis Bouras[1]

Co-authors: Barbara Betz [2]; Carsten Greiner [3]; Harri Niemi [4]; Oliver Fochler [5]; Zhe Xu

[1] *University of Frankfurt a.M.*

[2] *Frankfurt University*

[3] *University of Frankfurt*

[4] *Frankfurt Institute for Advanced Studies*

[5] *Goethe-Universität Frankfurt*

Corresponding Author: bouras@th.physik.uni-frankfurt.de

Using a microscopic transport model we investigate the evolution of conical structures originating from the supersonic jet
through the hot matter and dense matter of ultra-relativistic heavy-ion collisions. We found that the Mach cone angle
is influenced by the source term properties, energy deposition and viscosity. While in a static medium a possible
double-peak structure is overshadowed by the diffusion wake and head shock, it turns out that in central heavy-ion collisions
due to the radial flow of the expanding medium a double-peak structure is visible. On the one hand this is mainly contributed
from Mach cones propagating into the opposite direction of the radial flow, while on the other hand deflected jets may also
contribute to a final double-peak structure. The corresponding double-peak structure is observed insofar the shear viscosity over entropy density ratio is sufficiently small, while a larger dissipation destroys any kind of Mach cone and/or double-peak structure.

Hard Probes / 124

ATLAS high-pT measurements in lead-lead collisions

Author: Zvi Citron[1]

[1] *Weizmann Institute of Science (IL)*

Corresponding Author: zvi.citron@cern.ch

Measurements of high-pT processes in lead-lead collisions can provide insight on the physics responsible for the quenching of jets in the quark gluon plasma. Results will be presented from ATLAS measurements of single jet suppression, both inclusively and as a function of the azimuthal angle of the jets with respect to the elliptic flow plane, single jet fragmentation, and gamma-jet correlations. Theoretical comparisons to and implications of the results will be discussed. Also, results will be presented for measurements of photon, Z, and W production that provide essential tests on calculations of hard scattering rates and nuclear geometry.

Beam Energy Scan / 23

The elliptic flow and the shear viscosity of the QGP within a kinetic approach

Author: SALVATORE PLUMARI[1]

Co-authors: ARMANDO PUGLISI [2]; VINCENZO GRECO [1]

[1] *UNIVERSITY OF CATANIA, ITALY*

[2] *INFN-LNS*

Corresponding Author: salvatore.plumari@hotmail.it

We investigate within a parton cascade approach at fixed η/s ratio the effect of a temperature dependent
$\eta/s(T)$ at three different beam energies from RHIC for Au+Au at $\sqrt(s)$ =62.4, 200 GeV to LHC energies for
Pb+Pb at $\sqrt(s)$ =2.76 TeV. An important result is that for the different beam energies considered the
suppression of the elliptic flow due to the viscosity of the medium has different contaminations coming
from the cross-over (hadronic) or QGP phase depending on the average energy of the system. In particular, we
observe that at LHC the elliptic flow is less contaminated by the hadronic phase allowing a better study
of the QGP properties. We will show that the observed scaling of $v_2(p_T)$ from RHIC to LHC energies implies a fall and rise of $\eta/s(T)$ and allow to put a first constraint on $\eta/s(T)$.

[1] S. Plumari, A. Puglisi, F. Scardina, V. Greco, Phys.Rev. C86 (2012) 054902.

[2] S. Plumari, A. Puglisi, M. Colonna, F. Scardina, V. Greco, J.Phys.Conf.Ser. 420 (2013) 012029.

Heavy Flavour 2 / 46

Measurement of electrons from heavy-flavour decays in Pb-Pb collisions at √sNN = 2.76 TeV with ALICE

Author: Deepa Thomas[1]

[1] *University of Utrecht (NL)*

Corresponding Author: deepa.thomas@cern.ch

Measurement of electrons from heavy-flavour decays in Pb-Pb collisions at √sNN = 2.76 TeV with ALICE

Deepa Thomas (Utrecht University) for the ALICE Collaboration

The measurement of heavy-flavour (charm and beauty) production in ultra-relativistic heavy-ion collisions is an important probe to study the properties of the high temperature and density medium created in such collisions. Heavy quarks are useful to study the mechanism of parton energy loss, which is expected to be sensitive to the colour charge and mass of the parton. One approach to study heavy-flavour production is the measurement of electrons from semi-leptonic decays of heavy-flavour hadrons.

With the ALICE detector at the LHC, electrons are identified using several detectors in the central rapidity region, namely the Time Of Flight detector, the Time Projection Chamber, the Electromagnetic Calorimeter, and the Transition Radiation Detector. In this contribution we present the nuclear modification factor (RAA) which is the ratio of the yield in Pb-Pb collisions to the yield in binary scaled pp collisions, azimuthal anisotropy and elliptic flow (v2) which is the second Fourier coefficient of particle azimuthal distribution of heavy-flavour decay electrons as a function of transverse momentum. These two observables are sensitive to the interactions of c and b quarks with the medium. Further insight into the interaction of heavy quarks with the dense medium can be obtained by measuring azimuthal angular correlations of heavy-flavour decay electrons and charged hadrons in Pb-Pb collisions. We will also discuss results from this analysis.

Beam Energy Scan / 11

Higher moments of net kaon multiplicity distributions at RHIC energies for the search of QCD Critical Point

Author: Amal(for the STAR collaboration) Sarkar[1]

[1] *Indian Institute of Technology Bombay, Mumbai*

Corresponding Author: amal@rcf.rhic.bnl.gov

The Relativistic Heavy-Ion Collider (RHIC), at BNL, has started its beam energy scan(BES) program by colliding heavy-ions covering a wide range in baryonic chemical po- tential. One of the main goals of this beam energy scan program is to locate the critical point which is postulated to lie at the end of the phase transition boundary between partonic and hadronic matter. Finite temperature lattice QCD calculations at baryon chemical potential $_B$ = 0 suggest a crossover above a critical temperature from a system with hadronic degrees of freedom to a system where the relevant degrees of freedom are quarks and gluons. Several QCD based calculations find the quark-hadron phase transition to be first order at large $_B$. The point in the QCD phase plane (T vs $_B$) where the first order phase transition ends is the QCD critical point (CP). In a static, infinite medium, the correlation length (ξ) diverges at the CP. ξ is related to various moments of the distributions of conserved quantities such as net baryons, net charge, and net strangeness[1]. Typically variances ($^2 =< (N)^2 >$; ΔN = N – M ;where M is the mean) of these distributions are related to ξ as ^{2} ⊠ ^{2} [2]. Finite size and time effects in heavy-ion collisions put constraints on the values of ξ. A theoretical calculation suggests ξ ⊠ 2 – 3 fm for heavy-ion collisions[2, 3]. It was recently shown that higher moments of distributions of conserved quantities, measuring deviations from a Gaussian, have a sensitivity to CP fluctuations that is better than that of ^{2}, due to a stronger dependence on ξ[2, 3, 4]. The numerators in skewness $(S =< (N)^3 > /^3)$ go as $^{4.5}$ and kurtosis $(k = [< (N)^4 > /^4]-3) goas$ξ^{7}$ [5].

Summary:

Here we report the measurements of the various moments (standard deviation (σ), skewness (S) and kurtosis (k)) and their products (k^2 , Sσ) of the net kaon ($\Delta N_K = N_K^+ - N_K^-$) multiplicity measured by the STAR detector at mid-rapidity for Au+Au collisions at s_{NN} =7.7 to 200 GeV center of mass energies. The energy and centrality dependence of higher moments of net-kaons and their products (such as Sσ and k^2) will be presented in all BES energies. Theoretical calculations, containing the non-CP physics from the HIJING, AMPT, UrQMD models will be compared to the data.

Heavy Flavour 2 / 48

D meson nuclear modification factor and v2 in Pb-Pb collisions

Author: Elena Bruna[1]

[1] *Universita e INFN (IT)*

Corresponding Author: elena.bruna@cern.ch

D meson nuclear modification factor and v2 in Pb-Pb collisions

Elena Bruna (INFN Torino) for the ALICE Collaboration

The remarkable heavy-flavour results from RHIC and LHC show that heavy quarks are affected by the strongly coupled medium created in heavy-ion collisions at high energies. A way to characterize the properties of such a hot and dense medium is to quantify to what extent the medium influences the propagation of the particles through it, and how this varies for different parton species.
Given their large mass, heavy quarks are produced in the early stages of a heavy-ion collision and their abundance is not expected to change throughout the evolution of the system. Therefore, they

behave as self-generated probes that carry information of the medium by losing energy via subsequent interactions.
The high precision tracking, particle identification, and excellent vertexing capabilities of ALICE allow for measurements of heavy-flavoured particles in a wide momentum region.
We present the ALICE results on open heavy-flavour, focusing on the production of D0, D+, D*, and Ds mesons measured via the exclusive reconstruction of their hadronic decays displaced from the interaction vertex.
These measurements benefit from the large statistics of Pb-Pb collisions collected in 2011.
The results on the nuclear modification factor RAA for D mesons indicate a suppression of their yield in central collisions relative to binary-scaled pp collisions in a large momentum range. The comparison to the RAA of non-prompt J/Psi (measured by CMS) indicates a difference in the suppression of charm and beauty at high pT, as expected according to the predicted mass hierarchy in energy loss models.
The measurement of the azimuthal anisotropy of charmed mesons in semi-peripheral events is also discussed. The observed non-zero second Fourier harmonic v2 (elliptic flow) for 2<pT<6 GeV/c, together with the different D0 RAA along the event plane and orthogonally to it, could originate from the collective motion and path-length dependence of the energy loss of charm quarks. The results discussed above are also compared to various energy-loss models.

Hard Probes / 12

Tomography of QGP with jet asymmetries

Author: Guo-Liang Ma[1]

[1] *Shanghai INstitute of Applied Physics (SINAP), CAS*

Corresponding Author: glma@sinap.ac.cn

Within a multi-phase transport (AMPT) model, the transverse momentum asymmetries for γ-jet and di-jet are studied in Pb+Pb collisions at $\sqrt{s_{\rm NN}}$ = 2.76 TeV. A large asymmetry is produced by strong interactions between jets and partonic matter rather than by hadronic interactions only. It is demonstrated that final hadronic processes such as hadronization and hadronic rescatterings have little effects on the formed asymmetry. The asymmetry evolution functions are extracted to disclose that final asymmetry is driven by both initial asymmetry and partonic jet energy loss, which is consistent with jet energy loss in a hot and strongly interacting partonic medium. The imbalance or asymmetry ratio, e.g. $x_{j\gamma}$ or A_J, is sensitive to both production position and passing direction of γ-jet and di-jet, which could enable a detail tomographic study on the formed partonic matter by selecting different asymmetry ratio ranges experimentally.

References:
[1]Guo-Liang Ma, arXiv: 1302.5873
[2]Guo-Liang Ma, arXiv: 1304.2841

Heavy Flavour 2 / 54

Open-charm production as a function of charged-particle multiplicity in pp collisions at √s = 7 TeV with ALICE

Author: Renu Bala[1]

[1] *University of Jammu (IN)*

Corresponding Author: bala@to.infn.it

Open-charm production as a function of charged-particle multiplicity in pp collisions at √s = 7 TeV with ALICE

Renu Bala, for the ALICE Collaboration
University of Jammu, Jammu

Heavy quarks (charm and beauty) are an effective tool to investigate the properties of the Quark-Gluon Plasma in heavy ion collisions as they are produced in initial hard scattering processes and as they experience all the stages of the medium evolution. The measurement of heavy-flavour production cross sections in pp collisions at the LHC, besides providing a reference for heavy-ion studies, allows one to test perturbative QCD calculations. A brief review of ALICE results on the production of heavy flavoured hadrons measured from fully reconstructed decay topologies in pp collisions at √s = 2.76 and 7 TeV will be presented.

Furthermore, heavy-flavour production was also studied as a function of the particle multiplicity in pp collisions. This allows to investigate the interplay between hard and soft QCD processes and to study the role of multi-parton interactions. It is interesting to remark that the highest multiplicities reached in pp collisions at 7 TeV are similar to those measured in Cu-Cu collisions at RHIC energies. A measurement of the inclusive J/Psi yield as a function of the charged-particle pseudorapidity density was performed by the ALICE Collaboration at the LHC in pp collisions at √s = 7 TeV. An approximately linear increase of the J/Psi yield with increasing multiplicity was observed. In this context, the study of the yield of D mesons as a function of the charged-particle multiplicity could provide a deeper insight into charm-quark production in pp collisions. We will present the first results obtained for prompt D0, D+, and D*+ mesons using hadronic decay channels at midrapidity in pp collisions at √s = 7 TeV as a function of the charged-particle multiplicity. The prompt D meson yields as a function of multiplicity are measured in different pT intervals. These yields will be compared to the results obtained for inclusive and non-prompt J/Psi.

Hard Probes / 97

Appearance of a quark matter phase in hybrid stars

Author: Tomoki Endo[1]

[1] *Kagawa National College of Technology*

Appearance of a quark matter in the core region of hybrid stars is the main issue in such compact stars because the central density of the star is sufficiently high for the nuclear matter to undergo a further change into other exotic phase which consist of hyperons and quarks. Therefore a quark matter is expected in the core region but many theoretical calculation suggest that the inner structures of the star are strongly depend on the equation of states (EOS) of the matters. However the EOS for the high density matter is still not clear and recent several observations indicate the restrictions of the EOSs, theoretical studies should try to elucidate the EOSs in the high density and/or temperature. It is believed that the crust region of the stars consist of nucleus and nuclear matter and therefore the inner region of the stars should have hadron-quark mixed phase. We study the hadron-quark mixed phase with taking into account the finite-size effects and find that the mixed phase should be restricted to a narrower region, therefore a quark matter phase should appear in the central region[1]. Many studies show that the inner structures would affect macroscopic phenomena of the star, for instance, the quark core would give a new cooling curve[2].
References:
[1] T. Endo, Phys. Rev. C 83, 068801 (2011).
[2] R. Negreiros, V.A. Dexheimer and S. Schramm, Phys. Rev. C85, 035805(2012).

Beam Energy Scan / 42

Probing the QCD phase diagram with the measurements of ϕ-meson production and elliptic flow in the heavy-ion collision at STAR.

Author: Nasim Md[1]

[1] *NISER*

Corresponding Author: mnasim2008@gmail.com

The main goal of the Beam Energy Scan (BES) program at Relativistic Heavy Ion Collider (RHIC) is to study the QCD phase diagram by varying the colliding beam energy. Due to the small hadronic interaction cross-section, the yield and elliptic flow of the ϕ meson are primarily controlled by the partonic interaction in the relativistic heavy-ion collisions[1,2]. Therefore, the ϕ meson can be considered as a good probe for the phase boundary study in the BES program at RHIC. At top RHIC energy ($\sqrt{s_{NN}}$= 200 GeV) in Au + Au collisions, the ϕ meson has played an important role to establish that matter formed in such collisions is partonic. The number-of-constituent-quark scaling of the elliptic flow of the ϕ meson[3], enhancement in the yield of the ϕ meson in Au + Au collisions relative to $p + p$ collisions[4], and the ratio of yield of the Ω baryon to the yield of the ϕ meson as a function of p_T[3] have been the key measurements.
We will present transverse momentum dependence of yield and elliptic flow of the ϕ meson in Au + Au collisions at $\sqrt{s_{NN}}$= 7.7 - 200 GeV data collected in the years 2010 and 2011 by the STAR experiment. We will discuss the number-of-constituent-quark scaling of ϕ-meson v_2, nuclear modification factor R_{CP} and ratio of yield of the Ω baryon to the yield of the ϕ meson as a function of p_T. The implications of these results on the quark-hadron phase transition will be also discussed.

References:
[1] Md. Nasim, B. Mohanty and N. Xu, Phys. Rev. C 87 (2013) 014903.
[2] B. Mohanty and N. Xu, J. Phys. G 36 (2009) 064022.
[3] B. I. Abelev et al. [STAR Collaboration], Phys. Rev. Lett. 99 (2007) 112301.
[4] B. I. Abelev et al. [STAR Collaboration], Phys. Lett. B 673, (2009) 183.

Resonances / 62

Beam Energy Dependence of Strange Hadron Production from STAR at RHIC

Author: Feng Zhao[1]

[1] *University of California, Los Angeles*

Corresponding Author: fengzhao@physics.ucla.edu

Strange hadron production is believed to be sensitive to parton dynamics in nucleus-nucleus collisions, in particular, the strange quark production rate and its subsequent evolution in the dense partonic medium depend on the beam energy and the net baryon density. We will present STAR measurements of K_s, Λ, Ξ, Ω at mid-rapidity from Au+Au collisions at the beam energies of 7.7, 11.5, 19.6, 27 and 39 GeV from the RHIC Beam Energy Scan (BES) program. We investigate the strangeness enhancement and ratios of anti-baryon to baryon yields as a function of beam energy at RHIC. Nuclear modification factors and ratios of baryon to meson yields will also be discussed. Implications on collision dynamics due to the increase in the baryon chemical potential at low beam energy and constraints on chemical freeze-out parameters will also be discussed.

Strangeness 2 / 13

Elliptic ow of Λ, Ξ and Ω in 2.76 A TeV Pb+Pb collisions

Author: Huichao Song[1]

[1] *Peking U*

Corresponding Author: huichaosong@gmail.com

The elliptic flow of common hadrons (pions, kaons, and protons) are developed in both the QGP and the hadronic phase and are sensitive to the viscosity of the evolving fireball. For a precise extraction of the QGP viscosity from these flow data, Hybrid model calculations that combine hydrodynamic simulations of the expending QGP fluid with microscopic descriptions of the re-scattering hadronic gas are required. Multi-strange hadrons (ϕ, Ω, etc) with smaller hadronic cross sections are expected to decouple from the system earlier and might directly probe the QGP viscosity. In this talk, we will systematically study the elliptic flow of different multi-strange hadrons to test the QGP viscosity extracted from the elliptic flow of common hadrons. We will also extract effective early decoupling temperatures for different multi-strange hadrons through comparing the full hybrid model simulations and the pure hydrodynamic simulation with early decoupling.

Future / 41

Prospects for heavy flavour measurements with the ALICE inner tracker upgrade

Author: Cristina Terrevoli[1]

[1] *Universita e INFN (IT)*

Corresponding Author: cristina.terrevoli@cern.ch

Prospects for heavy flavour measurements with the ALICE inner tracker upgrade

C.Terrevoli, University and INFN of Cagliari, on behalf of the ALICE Collaboration

The ALICE detector is designed to investigate the properties of the hot and dense plasma of quarks and gluons, formed at the extreme energy densities reached in Pb-Pb collisions at LHC.
Among the probes useful to investigate this medium, heavy quarks play a special role because they are produced in the very initial stage of the collisions and they carry information about the properties of the traversed medium. In particular, an accurate measurement of heavy flavour provides information on fundamental properties of the medium as transport coefficients, the thermalization and hadronization mechanisms.
Interesting results have been obtained in the first three years of data-taking at the LHC, but there are still open questions, which would require measurements beyond the present capabilities of the ALICE apparatus. Among them, the most interesting are the measurement of the nuclear modification factor (R_AA) and anisotropy of the azimuthal distributions of charm
and beauty mesons down to transverse momentum below 1 GeV/c. Another completely unexplored field is the measurement of the production of heavy flavour baryons, like the Lambda_c and Lambda_b, that can bring insight on the heavy quark hadronization mechanism in the presence of a partonic medium.
At present such measurements are limited by the resolution of the inner tracking system, which, for instance, is not sufficient to measure in Pb-Pb collisions the production of Lambda_c baryons, that have a mean proper decay length of only 60 μm. Another limitation of the present ALICE central barrel detectors to the measurement of heavy flavours at low momentum, is the
maximum achievable readout rate, which prevents the full exploitation of the luminosity expected to be delivered by LHC after the Long Shutdown 2.
An upgrade of the inner tracking system based on today's frontier technologies has been recently approved. The new detector will improve by a factor 2-3 the current performance in
pointing and momentum resolution, providing in addition a high tracking efficiency down to very low transverse momentum. Moreover, a faster readout, for all the central barrel detectors,
will allow for a data collection rate, in Pb-Pb collisions, a factor 100 larger than at present, and this will contribute to enhance the ALICE physics performance very significantly.
In this contribution, we will present an overview of the inner tracker upgrade and the expected physics performance for heavy flavour measurements.

Resonances / 75

Resonance Production in sqrt(s) = 7 TeV pp collisions with ALICE.

Author: Graham Richard Lee[1]

[1] *University of Birmingham (GB)*

Corresponding Author: graham.richard.lee@cern.ch

The study of pp collisions at LHC energies is important not only as a baseline for future analysis in heavy-ion events at ALICE but also aiding in the calibration of QCD inspired models for LHC energies.
ALICE has measured the rho0, Sigma*and Csi* resonances in pp collisions at sqrt(s) = 7 TeV. This presentation will give an overview of the obtained results including transverse momentum spectra, ratios between the yields of these resonances and stable particles and <pT>.

Future / 21

NA61/SHINE experiment upgrade with vertex detector for open charm measurements

Author: Yasir Ali[1]

Co-author: Pawel Staszel [1]

[1] *Jagiellonian University*

A feasibility study for D0 meson (Open charm) measurements via its decay into two daughter particles, D0 $\longrightarrow$ K+ $\pi-$, in a central Pb-Pb collisions at SPS energies will be presented. To generate the physical input we use AMPT (A MultiPhase Transport model) event generator. We employed the GEANT4 application to describe particle transport through the experimental setup. The study is done assuming the NA61/SHINE experimental setup supplemented with a future vertex detector that allows for precise track vertex reconstruction at the target proximity. This detector will be used ultimately to measure open charm mesons in nucleusnucleus collisions at energies accessible at the CERN-SPS. The simulation results show that this measurement is feasible. The presentation will discuss the obtained results focusing on the predicted yields of D0 mesons and the possibilities of differential analysis. It will also address the issue of vertex detector optimization and the emphasis will be put on the prospect of the development of a vertex detector based on CMOS technology.

Strangeness 2 / 72

Multi-strange baryon production in Pb-Pb and pp collisions at √sNN = 2.76 TeV with the ALICE experiment at the LHC

Author: Domenico Colella[1]

[1] *Universita e INFN (IT)*

Corresponding Author: domenico.colella@cern.ch

Measurement of the production of strange and multi-strange particles is a fundamental tool in the investigation of the hot and dense QCD matter created in ultra-relativistic nucleus-nucleus collisions, as there is no net strangeness content in the initial colliding system.

Multi-strange baryons are measured in the ALICE apparatus through the reconstruction of the cascade topology of their weak decays into charged hadrons, exploiting the tracking and particle identification capabilities of the central barrel detectors.
The increased production of (multi-)strange (anti-)baryons in A-A collisions with respect to normal hadronic interactions (known as strangeness enhancement) and their nuclear modification factor RAA as a function of the transverse momentum and collision centrality are the main subjects of this contribution. Results in Pb-Pb collisions at √sNN = 2.76 TeV for five centrality intervals and in pp collisions at the same centre-of-mass energy will be
presented and compared with the corresponding lower energy nucleus-nucleus measurements.

Strangeness 2 / **74**

K0s and Lambda Production in ALICE

Author: Luke David Hanratty[1]

[1] *University of Birmingham (GB)*

Corresponding Author: luke.hanratty@cern.ch

The production of the Λ and ⊠0s hadrons at the LHC can be measured through the reconstruction of their weak decay topologies with only charged particles in the final state. The tracking and particle identification capabilities of the ALICE detector allow us to measure the spectra of these particles over a wide transverse momentum range (0.4 < pT < 12 GeV/c), and to precisely determine the behaviour of the baryon-to-meson ratio Λ/K0S.
Transverse momentum spectra and production yields at mid-rapidity for Λ and K0S will be presented for sqrt(s_NN) = 2.76 TeV Pb-Pb collisions as a function of centrality.
The evolution of the Λ/K0S ratio will be discussed, in comparison with corresponding results in pp collisions at the LHC and in sqrt(s) = 200 GeV Au-Au collisions at RHIC.

Future / **2**

The NICA project at JINR Dubna

Authors: Alexander Kovalenko[1]; Alexander Sorin[1]; Grigory Trubnikov[2]; Igor Meshkov[1]; Richard Lednicky[3]; Viktor Matveev[1]; Vladimir Kekelidze[1]

[1] *Joint Institute for Nuclear Research*
[2] *Joint Institute for Nuclear Research, Dubna*
[3] *Joint Institute for Nuclear Research, Dubna, Russia*

Corresponding Authors: alexander.sorin@cern.ch, vladimir.kekelidze@cern.ch

The NICA (Nuclotron-based Ion Collider fAcility) project is now under the realization stage at the Joint Institute for Nuclear Research (JINR, Dubna). The main goal of the project is an experimental study of hot and dense strongly interacting matter in heavy ion collisions at centre-of-mass energies √s_NN = 4 - 11 GeV (NN-equivalent) and the average luminosity of 10E27 cm-2 s-1 for Au(79+) in the collider mode (NICA collider). In parallel, fixed target experiments at the upgraded JINR superconducting synchrotron Nuclotron are carried out with extracted beams of various nuclei species up to Au(79+) with maximum momenta 13 GeV/c (for protons). The project also foresees a study of spin physics with extracted and colliding beams of polarized deuterons and protons at the energies up to √s = 26 GeV (for protons). The proposed program allows to search for possible signs of the phase transitions and critical phenomena as well as to shed light on the problem of nucleon spin structure. General design and construction status, physical program of the NICA complex is presented.

Resonances / 76

Hadronic resonances in heavy-ion collisions at ALICE

Author: Anders Garritt Knospe[1]

[1] *University of Texas (US)*

Corresponding Author: anders.knospe@cern.ch

Properties of the hadronic phase of high-energy heavy-ion collisions can be studied by measuring the ratios of hadronic resonance yields to the yields of longer-lived particles such as charged pions and kaons. These ratios can be used to study the strength of re-scattering effects, the chemical freeze-out
temperature, and the lifetime between chemical and kinetic freeze-out. The restoration of chiral symmetry during the early hadronic phase or near the phase transition may lead to shifts in the masses and increases in the widths of hadronic resonances. The ALICE collaboration has measured the spectra,
masses, and widths of the K(892)0 and phi(1020) resonances in Pb–Pb collisions at sqrt(s_NN) = 2.76 TeV.
These results, including R_CP, R_AA, mean transverse momenta, and the ratios of the integrated resonance yields to non-resonance hadron yields, will be presented and compared to results from other collision systems and theoretical predictions. Studies of resonance properties in p–Pb collisions provide a baseline measurement to which heavy-ion measurements can be compared; the status of the measurements of the phi(1020) meson in this collision system will be also reported.

Strangeness 2 / 103

Strangeness baryon to meson ratio

Author: Eleazar Cuautle Flores[1]

Co-author: Alejandro Ayala Mercado [2]

[1] *Universidad Nacional Autonoma (MX)*

[2] *National Autonomous University of Mexico*

Corresponding Author: eleazar.cuautle.flores@cern.ch

We present a model to compute baryon and meson transverse momentum distributions, and their ratios, in relativistic heavy ion collisions.
Our model allow to compute the probability to form colorless bound states of either two or three quarks as functions of the evolving density during the collision. The qualitative differences of the baryon to meson ratio for different collision energies and for different particle species can be associated to the different density dependent probabilities when accounting for the combinatorial factors which in turn depend on whether the quarks forming the bound states are heavy or light. We compare to experimental data and show that we obtain a good description up to intermediate values of pt.

Future / 26

Status and Challenges of the Compressed Baryonic Matter (CBM) Experiment at FAIR

Author: Hans Rudolf Schmidt[1]

[1] *University of Tuebingen*

Corresponding Author: hans-rudolf.schmidt@uni-tuebingen.de

The CBM experiment is one of the four scientific pillars of the Facility for Antiprotons and Ion Research (FAIR) in Darmstadt, Germany. Its discovery potential –complementary to heavy-ion experiments at colliders –is based on high-luminosity ion beams. This enables access to extremely rare probes such as charmed particles, vector mesons, multi-strange hyperons or even double hypernuclei with high statistics. However, 3rd generations readout systems and detectors are required to handle the large interaction rates (up to 10 MHz for Au+Au) with sufficient precision and bandwidth. In this contribution we will outline the unique CBM physics program and its relation to other, existing (RHIC-BES, SPS-NA61) or future (NICA-MPD) heavy-ion experiments in a similar energy range (2-35 AGeV). We will further elaborate on the demands and challenges, which are imposed by the high collision rates and event multiplicities on the different CBM detectors systems

Resonances / 59

Low mass vector meson production in pp and Pb-Pb collisions measured with ALICE at the LHC

Author: Alessandro De Falco[1]

[1] *Universita e INFN (IT)*

Corresponding Author: alessandro.de.falco@ca.infn.it

Low mass vector meson (ρ, ω, ϕ) production provides key information on
the hot and dense state of strongly interacting matter produced in high-energy heavy-ion collisions.
Among them, strangeness production can be accessed through the measurement of ϕ meson production. The detection of vector mesons through their decay in dileptons has the advantage, with respect to hadronic decays, that the decay products are not in
uenced by nal state interactions.
The ALICE apparatus at the LHC can access vector mesons produced at
forward rapidity ($2.5 < y < 4$) through their decays in muon pairs. We present results on vector meson production in pp and Pb-Pb collisions at
c.m. energy of 2.76 TeV per nucleon pair. The ϕ cross section is measured in pp collisions. In Pb-Pb collisions, a measurement of the ϕ/ρ + ω ratio and of the ϕ nuclear modication factor as a function of the collision centrality is obtained. The status of the analysis in p-Pb and Pb-p at
c.m. energy of 5.02 TeV per nucleon pair is also shown.

Plenary 10 / 136

Jet Quenching and Heavy Quarks

Author: Thorsten Renk[1]

[1] *University of Jyväskylä*

Corresponding Author: thorsten.i.renk@jyu.fi

Jet quenching is a cornerstone of the heavy-ion physics program at the LHC.
I review the current understanding of jet quenching in terms of a QCD shower evolution being modified by the surrounding medium, leading to copious medium induced radiation, and I outline the evidence for this picture from the light parton sector. Conceptually, the QCD shower description should also be relevant for heavy quarks, but with several important modifications.
I discuss why heavy quark jets (especially in the limit of small E_jet/m_q)
do not reflect the same physics as light quarks and give an overview over

current attempts to explain how the observed behaviour of heavy quark jets can be understood.

Plenary 10 / 95

Jet results from PbPb and pPb collisions with CMS

Authors: George Stephans[1]; The CMS Collaboration[2]

[1] *Massachusetts Inst. of Technology (US)*

[2] *CMS*

Corresponding Authors: george.stephans@cern.ch, sergeant@mail.cern.ch

We present a review of recent experimental results on jet production and properties in heavy-ioncollisions by the CMS Collaboration, with emphasis on jet-quenching and heavy quark jet production. These studies include various parton energy loss phenomena (dijet and photon-jet energy imbalance, jet shapes and fragmentation functions), a study of heavy quark jet production using b quark tagging technique, and measurements of jet pT and pseudorapidity distributions. All of the presented results utilize the high statistics pPb and PbPb data collected at the LHC.

Plenary 10 / 138

Results on angular correlations with ALICE

Author: Panos Christakoglou[1]

[1] *NIKHEF (NL)*

Corresponding Author: panos.christakoglou@cern.ch

Angular correlations are a sensitive probe of the transport properties of the system produced in heavy-ion collisions. Angular correlations measured in p−Pb have recently revealed intriguing features as well. In this talk, we will review the latest results on charged and identified particle correlations obtained with the ALICE detector at the LHC in both Pb−Pb and p−Pb events.

Plenary 11 / 99

Measurement of azimuthal anisotropy of hadrons in Au+Au collisions from the beam energy scan program by the PHENIX experiment at RHIC

Author: Yoshimasa Ikeda[1]

[1] *for the PHENIX collaboration, Riken*

Corresponding Author: y_ikeda@ribf.riken.jp

Large azimuthal anisotropy of particle emission in non-central heavy ion collisions has been has been clearly observed in heavy ion collision at RHIC since 2001. The elliptic flow as given by the second term of the Fourier series for the azimuthal distribution of particles with respect to the event

plane is believed to carry information on the initial geometrical anisotropy. One of the early observations was that in Au+Au collisions at 200 GeV, the elliptic flow of hadrons scales with number of constituent quarks, which may be an indication for flow of constituent quarks in a QGP phase. An event plane detector, RxP, was installed in the PHENIX experiment for 2007 data taking period, in order to improve the resolution of the event plane determination. The RxP detector also has allowed PHENIX make accurate measurements of elliptic flow at lower collision energies, where the transition of a QGP might be detected. The primary goal of beam energy scan program at RHIC energy is to search for the boundary between two phases of QCD matter: a gas of hadrons, and the Quark Gluon plasma. The latest elliptic flow measurement for identified hadrons in Au+Au collisions from the beam energy scan program at PHENIX will be presented and discussed.

Summary:

Elliptic flow v2 of π+,π-,K+,K-,p,p,d were measured at Au+Au √sNN=200, 62 and 39GeV at PHENIX.
Proton v2 and anti-proton v2 are deviated. The difference increases to low energy collision and is flat to momentum. It leaving from number of constituent quarks scaling at low energy collision.
π- v2 has slightly larger than π+. K v2 has no difference for +/- charge.

Plenary 11 / 132

Status and Physics Opportunities of STAR Heavy Flavor Tracker and Muon Telescope Detector Upgrades

Author: Hao Qiu[1]

[1] *Lawrence Berkeley National Laboratory*

Corresponding Author: hqiu@lbl.gov

The STAR Collaboration will complete the Heavy Flavor Tracker (HFT) and the Muon Telescope Detector (MTD) upgrades by 2014. HFT utilizes the state-of-art active thin pixel detector technology, which will greatly enhance STAR physics capability by measuring heavy quark collectivity and correlations via the topological reconstruction of charmed hadrons over a wide momentum range. MTD is based on the long Multi-Gap Resistive Plate Chamber detector technology designed to measure muons penetrating the bulk of other detectors and the magnet yoke. It will enable STAR to study dimuon and electron-muon correlations and enhance heavy quarkonium studies. With the addition of these upgrades, STAR is well suited to perform precise measurements of production as well as correlations of rare probes (heavy flavors, dileptons) to systematically investigate the quark-gluon plasma properties at RHIC. For the ongoing Run 13 63% of the MTD has been installed and data have been taken. And prototype PXL sectors (30% coverage) have also been installed and commissioned. Anticipated physics results and current status of these upgrades will be reported.

Plenary 11 / 40

Strangeness balance in HIC

Author: Evgeni Kolomeitsev[1]

Co-authors: Boris Tomasik [2]; Dmitry Voskresensky [3]

[1] *Matej Bel University*

[2] *Univerzita Mateja Bela*

[3] *MEPhI, Moscow, Russia*

Corresponding Author: e.kolomeitsev@gsi.de

We discuss the strangeness production in heavy-ion collisions at SIS-FAIR-NICA energies
and the role of doubly and triply strange baryons for testing the strangeness balance in a collision event. The minimal statistical model is applied, in which the total strangeness yield is fixed by the observed K+ multiplicity. Exact strangeness conservation in each collision event is explicitly preserved. This implies for instance that Xi baryons can be released only in events where two or more kaons are produced. The influence of in-medium effects and centrality bias on the strange particle production is analyzed. The puzzling enhancement of Xi yields is discussed and arguments in favor of the Xi production in direct reactions are given. Various mechanisms for Xi productions are reviewed.

Thermal models/Hydro / 38

Production of Strange, Non-Strange Particles and Hypernuclei in an Excluded-Volume Model

Author: Swatantra Kumar Tiwari[1]

Co-author: C. P. Singh [1]

[1] *Banaras Hindu University*

Corresponding Author: sktiwari4bhu@gmail.com

Recently, we proposed a thermodynamically consistent excluded-volume model for a hot, dense hadron gas (HG). We confront our model calculations on various properties of HG, multiplicity and ratios of various strange and non-strange particles in the entire range of temperature and baryon densities with the other models and experimental data and we find that our model describes the experimental data suitably in comparison to other models. Furthermore, we numerically show that our model respects causality while most of the excluded-volume models suffer from this deficiency. Our model describes the production of strange particles satisfactorily but fails in describing multistrange particles (i. e. \phi, \Omega etc.) production. So, we need another kind of mechanism to describe the production of multistrange particles successfully. We test our model in getting the rapidity as well as transverse mass spectra of various strange and non-strange hadrons. We find that our model with the effect of flow describes the experimental data on transverse mass spectra and rapidity distributions very well. Further, we analyze the production of light nuclei, hypernuclei and their anti-nuclei over a broad energy range from Alternating Gradient Synchrotron (AGS) to Large Hadron Collider (LHC) energies using our excluded-volume model. We again find a good agreement between our model calculations and experimental data. Thus, we conclude that our excluded-volume model is a proper equation of state (EOS) for hot and dense HG.

Summary:

Our analysis shows that, our excluded-volume model is capable of describing almost all the features of hot and dense hadron gas (HG) and hence it is a proper equation of state for hot, dense HG. Although, our model is an approximate thermodynamically consistent because we use Neumann iteration series to calculate no. density of baryons in which we take only few order of terms.

Quarkonia/Heavy Flavour / 88

Quarkonia production and suppression in heavy ion collisions at STAR

Author: Daniel Kikola[1]

[1] *Warsaw University of Technology*

Corresponding Author: dkikola@gmail.com

Suppression of quarkonia production in high energy nuclear collisions relative to proton-proton collisions, due to the Debye screening of the quark-antiquark potential, was proposed as a signature of the formation of the Quark-Gluon Plasma (QGP). Measurement of production of various quarkonia states can provide insight into thermodynamic properties of the QGP since different states have different binding energy and therefore disassociate at different temperature. However, there are other effects that may affect the observed production, such as cold nuclear matter effects, final state nuclear absorption and statistical coalescence of quark-antiquark pairs. Study of quarkonia production for different colliding systems, collision energies and centralities can help to disentangle the interplay of these mechanisms and to understand the medium properties.

In this talk we report on recent STAR results on J/psi and Upsilon production and suppression at midrapidity in Au+Au collisions at RHIC. We present J/psi invariant yield and nuclear modification factor as a function of centrality and transverse momentum at $\sqrt{s_{NN}}$ = 200, 62.4 and 39 GeV and discuss the energy dependence of the J/psi production. We also present Υ nuclear modification factor in Au+Au and d+Au collisions at 200 GeV calculated using high statistics p+p data taken in 2009.

p-A collisions / 47

Measurement of D meson production in p-Pb collisions with the ALICE detector

Author: Grazia Luparello[1]

[1] *NIKHEF (NL)*

Corresponding Author: grazia.luparello@cern.ch

Measurement of D meson production in p-Pb collisions with
the ALICE detector

Grazia Luparello (NIKHEF and Utrecht University) for the ALICE Collaboration

The ALICE Collaboration has measured the production of prompt D^0, D^+ and D^{*+} mesons in Pb-Pb and pp collisions by fully reconstructing their hadronic decays. A large suppression of D meson yield in the most central Pb-Pb collisions with respect to the binary-scaled pp yield was observed in a broad p_T-range. This effect is consistent with the energy loss of charm quarks while they traverse the hot and dense medium formed in such collisions.

To come to a quantitative understanding of these results, it is important to disentangle hot nuclear matter effects from initial-state effects due to cold nuclear matter, such as modification of the parton distribution functions in the nucleus, in particular nuclear shadowing, and saturation effects.

Between January and February 2013, ALICE collected a data sample of minimum bias p-Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV. The study of the D meson production in this collision system, where a hot nuclear medium is not expected to be formed, will quantify the role of initial-state effects.

In this talk, the first results on D meson production in p-Pb collisions obtained in the $D^0 \to K^-\pi^+$, $D^+ \to K^-\pi^+\pi^+$, $D^{\star+} \to D^0\pi^+$ decay channels in the central rapidity region will be presented.

p-A collisions / 50

Measurement of electrons from heavy-flavour hadron decays in pp and p-Pb collisions with ALICE

Author: Markus Ansgar Heide[1]

[1] *Westfaelische Wilhelms-Universitaet Muenster (DE)*

Corresponding Author: markus.ansgar.heide@cern.ch

Measurement of electrons from heavy-flavour hadron decays in pp and p-Pb collisions with ALICE at the LHC

Markus Heide for the ALICE Collaboration, WWU Münster

Charm and beauty quark production in hadronic collisions occurs mostly in initial parton scattering processes with high virtuality. The measurement of heavy-flavour decay electrons in pp collisions with the ALICE detector represents therefore a crucial test of pQCD predictions on heavy-flavour production. At the same time, it provides an essential reference for measurements in Pb-Pb collisions, where heavy quarks are important probes for the investigation of energy-loss mechanisms in the Quark-Gluon Plasma. The influence of cold nuclear matter effects (e.g. gluon saturation, nuclear shadowing, and the Cronin effect) on the electron spectrum can be inferred from the analysis of p-Pb collisions.

ALICE makes use of its central barrel detectors TPC, TOF, TRD, and EMCal to identify electrons at mid-rapidity. From these, background electrons from decays of light mesons and photon conversions are subtracted, based on respective preceding ALICE measurements. The resulting yield of heavy-flavour hadron decay electrons is measured down to a transverse momentum of 0.5 GeV/c. In addition, the high precision vertex reconstruction with the Inner Tracking System allows for a separate determination of the electron yield from B-meson decays, either from displaced single electrons or from secondary vertices. Alternatively, the contribution from beauty-hadron decays to the inclusive spectrum of electrons from heavy-flavour hadron decays is determined via the azimuthal angular correlation between electrons and charged hadrons. Measurements of the pT-differential electron production cross sections from inclusive heavy-flavour hadron and B-meson decays in pp collisions at √s = 2.76 and 7 TeV will be presented. Furthermore, a first look will be taken at the inclusive electron spectrum from heavy-flavour hadron decays in p-Pb collisions at √sNN = 5.02 TeV.

Thermal models/Hydro / 114

Event-by-event correlation between medium flow and jet flow

Author: Denes Molnar[None]

Co-author: Deke Sun [1]

[1] *Purdue University*

Corresponding Author: molnar@physics.purdue.edu

It is well-known that a nonzero initial spatial eccentricity in a heavy-ion collision is reflected in the final anisotropic flow of the bulk medium. Jets traversing a spatially anisotropic medium also develop momentum anisotropy (at fixed pT) through path length dependence of energy loss. For smooth initial conditions, bulk and jet flow anisotropy coefficients are naturally related. However, more realistic initial condition models include large fluctuations in the initial transverse profile of the medium with "hot spots" that induce a nontrivial bulk and jet response in momentum space. We present results on the correlation between the bulk and jet flow anisotropy pattern in A+A at RHIC and LHC, from a calculation that combines covariant transport theory for the bulk medium evolution with jet energy loss for high-pT light and heavy-flavor production.

Quarkonia/Heavy Flavour / 98

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

Author: Su Houng Lee[1]

Co-authors: Che Ming Ko [2]; Kenji Morita [3]; Taesoo Song [2]

[1] *Yonsei University*

[2] *Texas A&M*

[3] *Kyot University*

Corresponding Author: suhoung@gmail.com

Using the QCD sum rule with its operator product expansion reliably
estimated 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\"odingier equation for a charm and anticharm quark pair 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 has resolved the long-standing
question of whether the free energy potential or the internal energy
potential should be used in analyzing the spectrum of heavy quark
systems at finite temperature.

Thermal models/Hydro / 61

Strangeness at high temperatures

Author: Christian Schmidt[1]

[1] *University of Bielefeld*

Corresponding Author: schmidt@physik.uni-bielefeld.de

Appropriate combinations of up to fourth order cumulants of net strangeness fluctuations and their correlations with net baryon number and electric charge fluctuations, obtained from ab-initio Lattice QCD calculations, have been used to probe the strangeness carrying degrees of freedom at high temperatures. For temperatures up to the chiral crossover separate contributions of strange mesons and baryons can be well described by an uncorrelated gas of hadrons. Such a description breaks down immediately after the chiral crossover region, suggesting that the deconfinement of strangeness takes place at the chiral crossover. On the other hand, the strangeness carrying degrees of freedom inside the quark gluon plasma can be described by a weakly interacting gas of quarks only for temperatures larger than twice the chiral crossover temperature. In the intermediate temperature window these observables show considerably richer structures, indicative of the strongly interacting nature of the quark gluon plasma.

Quarkonia/Heavy Flavour / 106

Heavy quark quenching from RHIC to LHC: MC@HQ generator compared to experiements

Author: Pol Gossiaux[1]

[1] *Subatech*

Corresponding Author: gossiaux@subatech.in2p3.fr

Recently, we have proposed a microscopic approach for the quenching and thermalisation of heavy quarks (HQ) in URHIC [1-4], assuming that they interact with light partons through both elastic and radiative processes evaluated by resorting to some parameterization of the running coupling constant, while those partons are spatially distributed along hydrodynamical evolution of the hot medium. This approach is able to explain successfully several observables measured at RHIC and LHC, such as the nuclear modification factor and the elliptic flow of open heavy flavor mesons and non-photonic single electrons. The diffusion coefficient of heavy quarks in the quark gluon plasma – a fundamental property of this state of matter –
can thus be extracted and compared with recent lattice calculations.

In this contribution, we would like to provide a general overview of our MC@HQ event generator and discuss the predictions of our model for D and B mesons and lepton production in URHIC and confront them with experimental results obtained so far by the various collaborations at RHIC and LHC. A particular focus will be devoted to the impact of the backgound medium, using several hydrodynamical schemes available nowadays. Perspectives for future observables like correlations will be proposed.

[1] P.B. Gossiaux, J. Aichelin, Phys. Rev. C78, 014904 (2008), [hep-ph/0802.2525].

[2] P.B. Gossiaux, R. Bierkandt, J. Aichelin, Physical Review C79 (2009) 044906.

[3] P.B. Gossiaux, V. Guiho, J. Aichelin, J. Phys. G: Nucl. Part. Phys. 37 (2010) 094019.

[4] P.B. Gossiaux et al., accepted for publication in Nuclear Physics A [arXiv:1209.0844].

p-A collisions / 55

D meson-hadron angular correlations in pp and p-Pb collisions with ALICE at the LHC

Author: Fabio Filippo Colamaria[1]

[1] *Universita e INFN (IT)*

Corresponding Author: fabio.colamaria@cern.ch

Fabio Filippo Colamaria, for the ALICE Collaboration

ALICE measured a significant suppression of D-meson production in a wide momentum range in central Pb-Pb collisions with respect to the expectation based on the cross section measured in pp collisions, scaled by the number of nucleon-nucleon collisions. This effect can be, at least partially, attributed to the energy loss by charm quarks through the interaction with the Quark Gluon Plasma formed in such collisions. The comparison of angular correlations between charmed mesons and charged hadrons produced in pp, p-Pb and Pb-Pb collisions can give insight into the mechanisms through which charm quarks lose energy and help to spot possible modifications of their hadronisation induced by the presence of the medium. The analysis of pp and p-Pb data and the comparison with predictions from pQCD calculations, besides constituting the necessary baseline for the interpretation of Pb-Pb data, can provide relevant information on charm production and fragmentation processes.

We will present a study of azimuthal correlations between D0, D+, and D* mesons and charged hadrons in pp collisions at $\sqrt{s}$ = 7 TeV and p-Pb collisions at $\sqrt{s}$ = 5.02 TeV. D mesons were reconstructed from their hadronic decays at central rapidity and in the transverse momentum range 2 ≤ pT ≤ 16 GeV/c and were correlated to charged hadrons reconstructed in the pseudorapidity range $|\eta|<0.8$. Perspectives for the measurement in Pb-Pb collisions at $\sqrt{s}$ = 2.76 TeV will be also discussed.

p-A collisions / 56

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

Author: Igor Lakomov[1]

[1] *Universite de Paris-Sud 11 (FR)*

Corresponding Author: igor.lakomov@cern.ch

Production of charmonia, bound state of c and cbar quarks, is an intense research activity, both experimentally and theoretically. In addition, 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), formed in heavy-ion collisions.
ALICE is dedicated to the study of QGP properties in heavy-ion collisions at the LHC. It measured J/psi suppression in Pb-Pb collisions at the energy of 2.76 TeV per nucleon pair. At the beginning of 2013, p-Pb collisions at the energy of 5.02 TeV per nucleon pair 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. Their evaluation is important in order to be able to disentangle, in Pb-Pb collisions, hot and cold nuclear matter effects. First results on the J/psi production in p-Pb collisions, in the dimuon decay channel at forward rapidity, will be presented and compared to theoretical models.

Quarkonia/Heavy Flavour / 107

Jet suppression at LHC: theory vs. experiment

Author: Magdalena Djordjevic[1]

[1] *Institute of Physics Belgrade, University of Belgrade, Serbia*

Corresponding Author: magda@ipb.ac.rs

Suppression of light and heavy flavor observables is one of the most important probes in studying the properties of QCD matter created at RHIC and LHC experiments. We will here provide the most up-to-date light and heavy flavor suppression predictions for the available (2.76TeV) and the upcoming (˜5TeV) Pb+Pb collisions at LHC. The predictions are based on our recent improvements in the energy loss calculations that take into account: i) theoretical formalism which includes finite magnetic mass [1], ii) finite size dynamical QCD medium [2], iii) numerical procedure which includes path-length and multi-gluon fluctuations [3]. We recently showed that these improvements may provide a reasonable explanation of the "Heavy flavor puzzle at RHIC" [3], while predictions for the available and the upcoming LHC data will be presented here.

[1] M. Djordjevic and M. Djordjevic, Physics Letters B 709, 229 (2012).
[2] M. Djordjevic, Phys. Rev. C 80, 064909 (2009) (highlighted in: M Gyulassy, Physics 2, 107 (2009)).
[3] M. Djordjevic, Phys. Rev. C 85, 034904 (2012).

Thermal models/Hydro / 14

Systematic Properties of the Tsallis Distribution: Energy Dependence of Parameters

Author: Jean Cleymans[1]

[1] *University of Cape Town*

Corresponding Author: jean.cleymans@gmail.com

Changes in the transverse momentum distributions with beam energy
are studied using the Tsallis distribution as a parameterization.
The dependence of the Tsallis parameters q, T and the volume
are determined as a function of beam energy.
The Tsallis parameter q shows a weak but clear increase with beam energy
with the highest value being approximately 1.15.
The Tsallis temperature and volume are consistent with being independent
of beam energy within experimental uncertainties.

Summary:

Changes in the transverse momentum distributions with beam energy
are studied using the Tsallis distribution as a parameterization.
The dependence of the Tsallis parameters q, T and the volume
are determined as a function of beam energy.
The Tsallis parameter q shows a weak but clear increase with beam energy
with the highest value being approximately 1.15.
The Tsallis temperature and volume are consistent with being independent
of beam energy within experimental uncertainties.

Thermal models/Hydro / **22**

Elliptic Flow from fKLN Initial Conditions

Author: francesco scardina[1]

Co-authors: Marco Ruggieri [2]; Salvatore Plumari [2]; Vincenzo Greco [2]

[1] *INFN Catania*

[2] *University of Catania*

Corresponding Author: scardinaf@lns.infn.it

A current goal of relativistic heavy ion collisions experiments
is the search for a Color Glass Condensate as the limiting state of QCD matter at very high density.
In viscous hydrodynamics simulations, a standard Glauber initial condition leads to estimate $4\pi\eta/s \sim 1$, while
a Color Glass Condensate modeling leads to at least a factor of 2 larger η/s.
Within a kinetic theory approach based on a relativistic Boltzmann-like transport simulation,
we point out that the out-of-equilibrium initial distribution proper of a Color Glass Condensate
reduces the efficiency in building-up the elliptic flow. We study the dynamical impact of Color Glass Condensate at both RHIC and LHC energies.
Our main result at RHIC energy is that the available data on v_2
are in agreement with a $4\pi\eta/s \sim 1$ also for Color Glass Condensate initial conditions,
opening the possibility to describe self-consistently also higher order flow, otherwise significantly underestimated,
and to pursue further the search for signatures of the Color Glass Condensate.

[1] M. Ruggieri, F. Scardina, S. Plumari, V. Greco, arXiv:1303.3178 [nucl-th].

[2] S. Plumari, V. Baran , M. Di Toro, G. Ferini, V. Greco, Phys.Lett. B689 (2010) 18-22.

Quarkonia/Heavy Flavour / **110**

Semi-classical approach to J/psi suppression in high energy heavy-ion collisions

Authors: Roland Katz[1]; Roland Katz[2]

Co-author: Pol Gossiaux [2]

[1] *SUBATECH*

[2] *Subatech*

Corresponding Authors: gossiaux@subatech.in2p3.fr, roland.katz@subatech.in2p3.fr

Quarkonia suppression in heavy ion collisions has been investigated as a probe to Quark-Gluon Plasma properties and was indeed observed at SPS. However, the saturation of the suppression observed at RHIC and then is decrease at LHC has triggered the interest of our community and leads to consider alternate schemes as those based on sequential suppression in a stationary medium. In our contribution, we study the evolution of a quark-antiquark pair in a cooling isotropic QGP medium. For this purpose we use two different approaches: a) the semi-classical evolution equation proposed by C. Young and E. Shuryak [1] and b) a quantum evolution equation of the open QQbar system, better suited to study the evolution of bound states. We consider for both approaches different color screening potentials, temperature scenarios at RHIC and LHC, charmonium and bottomonium bound states, and thermalisation processes. A comparison to previous results [1][2][3] is finally carried out.

[1] C. Young and E. Shuryak, Phys. Rev. C 79, 034907 (2009)
[2] Y. Akamatsu and A. Rothkopf, Phys.Rev. D85 (2012) 105011
[3] M. Strickland and D. Bazow, Nuclear Physics A 879, 25-58 (2012)

p-A collisions / 64

Two-particle correlations in p-Pb collisions at the LHC with ALICE

Author: Leonardo Milano[1]

[1] *CERN*

Corresponding Author: leonardo.milano@cern.ch

The double ridge structure previously observed in Pb-Pb collisions has also been recently observed in high-multiplicity p-Pb collisions at \sqrt{s_{NN}} = 5.02 TeV. These systems show a long-range structure (large separation in $\Delta\eta$) at the near- ($\Delta\phi = 0$) and away-side ($\Delta\phi = \pi$) of the trigger particle. In order to understand the nature of this effect the two-particle correlation analysis has been extended to identified particles. Particles are identified up to pT values of 4GeV/c using the energy loss signal in the Time Projection Chamber detector, complemented with the information from the Time of Flight detector. This measurement casts a new light on the potential collective (i.e. hydrodynamic) behavior of particle production in p-Pb collisions.

Quarkonia/Heavy Flavour / 79

Studies of Onia and Strangeness Production in Proton-proton Collisions at LHCb

Authors: Marta Calvi[1]; Nicholas Brook[2]

[1] *Universita & INFN, Milano-Bicocca (IT)*

[2] *University of Bristol (GB)*

Corresponding Authors: nick.brook@cern.ch, marta.calvi@mib.infn.it

Studies of strangeness and quarkonia production in the forward region provide important input to the understanding of QCD models in a kinematical range where they have large uncertainties. The LHCb experiment has collected a dataset corresponding to an integrated luminosity of about 3 fb-1 in proton-proton collisions at sqrt(s)= 7 and 8 TeV, as well as smaller samples recorded with other LHC operating modes. We present the latest studies of the production of kaons, Lambda baryons, and quarkonia states.

p-A collisions / 71

Transverse Momentum Distributions of Identified Particles in p–Pb collisions at sqrt(s_NN) = 5.02 TeV

Author: Jonas Anielski[1]

[1] *Westfaelische Wilhelms-Universitaet Muenster (DE)*

Corresponding Author: jonas.anielski@cern.ch

Recent measurements of di-hadron correlations in p–Pb collisions at sqrt(s_NN) = 5.02 TeV revealed a double-ridge pattern, reminiscent of the one observed in Pb–Pb collisions.
This raises the question of the possible existence of collective effects in high multiplicity p–Pb collisions. Further insight into the observed phenomena can be gained by studying the evolution of spectral shapes with the particle mass and particle ratios as a function of charged-particle density.
Transverse momentum (pT) distributions of hadrons have been measured at midrapidity (0. < yCMS < 0.5). Particles are reconstructed with the central barrel detectors
over a wide transverse momentum range (0 GeV/c up to 6 GeV/c) and different identification techniques are used. Primary charged particles (pi±,K±, p and ¯p) are identified by their specific energy loss (dE/dx) and time-of-flight. Weakly decaying
particles (K0s, Lambda and antiLambda) are identified by their characteristic decay topology.
Particle-production yields, spectral shapes and particle ratios are measured in several multiplicity classes and are compared with results obtained in Pb–Pb collisions at
sqrt(s_NN) = 2.76 TeV at the LHC.

Thermal models / 81

Thermalization through Hagedorn-States

Author: Maxim Beitel[1]

Co-authors: Carsten Greiner [1]; Kai Gallmeister [1]

[1] *Institut für Theoretische Physik, Goethe Universität*

Corresponding Author: beitel@th.physik.uni-frankfurt.de

We examine the evolution of a heavy ion collision starting from non-equilibrium to an equilibrium state by looking at the corresponding thermalization times. Therefore we use the hadronic transport model "UrQMD" as microscopic model for high-energetic heavy ion collisions. Unfortunately these times are too long at present because detailed balance is not realized for all collisions which may occur. This especially holds for strange mesons like Kaons and hypreons like Lmabda, Sigma. etc.. In order to get rid of this drawback we deploy non-strange and strangeness-carrying Hagedorn-States proposed by the "Statistical Bootstrap Model". We study the question, whether creation of these

states in binary collisions and their decay into two particles only will lower the thermalization times in UrQMD.

Quarkonia/Heavy Flavour / 58

Measurements of J/psi to ee with ALICE at the LHC

Author: Fiorella Fionda[1]

[1] *Universita e INFN (IT)*

Corresponding Author: fiorella.fionda@cern.ch

The ALICE detector provides excellent capabilities to study quarkonium production at the Large Hadron Collider (LHC). Quarkonia, bound states of heavy (charm or bottom) quark anti-quark pairs such as the J/psi, are expected to be produced by initial hard processes. Thus they will provide insight into the earliest and hottest stages of A-A collisions where the formation of a Quark-Gluon Plasma (QGP) is expected. Furthermore, high-precision data from pp collisions represent an essential baseline for the measurement of nuclear modifications in heavy-ions and serve also as a crucial test for several models of quarkonium hadroproduction. In addition, the study of pA collisions allows to investigate nuclear modifications due to cold nuclear matter effects.
In ALICE, J/psi have been measured in pp, p-Pb and Pb-Pb down to pT = 0 via their di-electron decay channel in the central barrel (|y| < 0.9). Results on the nuclear modification factor (RAA) at central rapidities in Pb-Pb collisions at sqrt{sNN} = 2.76 TeV, as well as a first look into p-Pb data at sqrt{s} = 5.02 TeV will be shown and their implications discussed. A separation of the prompt and non-prompt components is also possible down to a pT of the J/psi of a few GeV/c, which allows to study the beauty hadron nuclear modification factor down to almost zero pT.

Hypernuclei / 129

Recent results on ultra-peripheral Pb-Pb and p-Pb collisions at the ALICE experiment

Author: Daniel Tapia Takaki[1]

[1] *Universite de Paris-Sud 11 (FR)*

Corresponding Author: daniel.tapia.takaki@cern.ch

The electromagnetic fields surrounding the protons and nuclei, accelerated by the LHC, lead to very large cross sections for photon-induced processes. This makes the LHC the world's most powerful collider not only for protons and lead ions but also for photon-photon and photon-hadron collisions. These interactions can be studied in ultra-peripheral collisions, where the impact parameters are larger than the sum of the nuclear radii and hadronic interactions are suppressed.

Exclusive vector meson production in heavy-ion collisions is expected to probe the nuclear gluon density, for which there is considerable uncertainty at low values of Bjorken-x. The first LHC measurement on UPC was recently carried out with the ALICE experiment [1-2]. During the 2010 and 2011 Pb+Pb runs at the LHC, as well as in the p+Pb run in 2013, ALICE collected data using dedicated triggers to select ultra-peripheral collisions. These triggers were based on the Muon spectrometer, the Time-of-Flight detector, the Silicon Pixel detector, and the VZERO scintillator array. Information from other detectors was also used in the analysis, mainly to ensure the exclusivity of the reaction. The photoproduction cross section of J/ψ meson at forward and central rapidities in Pb-Pb collisions have been measured [1-2]. These results have been compared to model calculations and their implications for nuclear gluon shadowing will be discussed in this talk.

Furthermore, first results on exclusive J/ψ photoproduction in p+Pb collisions will be given. Other ongoing analyses on ultra-peripheral collisions will also be discussed.

1. B.Abelev,etal.(ALICECollaboration) Phys.Lett.B718(2013)1273-1283

2. E.Abbas,etal.(ALICECollaboration) http://arxiv.org/abs/arXiv:1305.1467

Quarkonia/Heavy Flavour / **57**

Charmonium production measurements in Pb-Pb collisions with ALICE at the LHC

Author: Lizardo Valencia Palomo[1]

[1] *Universite de Paris-Sud 11 (FR)*

Corresponding Author: lizardo.valencia.palomo@cern.ch

ALICE (A Large Ion Collider Experiment), one of the four main experiments at the Large Hadron Collider (LHC), was designed and built to perform dedicated research on heavy-ion collisions to study the Quark-Gluon Plasma (QGP), a deconfined state of strongly interacting QCD matter.
As heavy flavours are produced on a very short time-scale in the initial hard scattering processes, they can be used to characterize the hot and dense medium formed in high-energy heavy-ion collisions through their modified yield as compared to pp collisions. In particular, the production c-cbar bound states was proposed as a thermometer of the created medium.
In ALICE, charmonium production is measured via the dielectron and dimuon decay channels at central (|y| < 0.9) and forward (2.5 < y < 4) rapidity, respectively.
In this talk, final results on charmonium production in Pb-Pb collisions at sqrt{s_{NN}} = 2.76 TeV will be presented and compared to theoretical models, with emphasis on the measurements at forward rapidity using the Muon Spectrometer.

Thermal models / **33**

Dynamical freeze-out criterion in event-by-event hydrodynamics

Author: Pasi Huovinen[1]

Co-author: Hannu Holopainen

[1] *Frankfurt Institute for Advanced Studies*

In hydrodynamical modeling of the ultrarelativistic heavy-ion collisions the freeze-out is typically performed at a constant temperature. In this work we introduce a dynamical freeze-out

criterion, which compares the hydrodynamical expansion rate with the pion scattering rate [1]. Previous studies [2] have shown that differences between constant temperature and dynamical freeze-out criteria are small in the transverse momentum spectra, but the effect on flow anisotropies has not yet been studied. Recently many calculations have been done using event-by-event hydrodynamics, in which case the expansion rate does not necessarily behave as nicely as in the case of smooth initial conditions. Thus it is interesting to check how the dynamical freeze-out changes hadron distributions with respect to the constant temperature freeze-out.

In this contribution we present hadron spectra and elliptic and triangular flow calculated using (2+1)-dimensional ideal hydrodynamics, and show the differences between constant temperature and dynamical freeze-out criteria. First we discuss the systematics of the dynamical freeze-out, and for simplicity these calculations have been performed using smooth initial states. Finally dynamical freeze-out condition is applied to event-by-event calculations to evaluate v_2 and v_3. We find that in event-by-event calculations, pion v_2 is sensitive to the freeze-out criterion.

[1] C. M. Hung and E. V. Shuryak, Phys. Rev. C 57, 1891 (1998).
[2] K. J. Eskola, H. Niemi and P. V. Ruuskanen, Phys. Rev. C 77, 044907 (2008).

Hypernuclei / **45**

Production of antinuclei and hypernuclei in a relativistic heavy-ion collisions

Author: Subrata Pal[1]

[1] *Tata Institute of Fundamental Research, Mumbai*

Corresponding Author: spal@tifr.res.in

The production of light nuclei, hypernuclei and their antiparticles in relativistic energy heavy ion collisions are explored within a relativistic Hagedorn Resonance Gas (HRG) model. In the HRG model the unknown heavy-mass resonance spectra is characterized by an exponentially growing Hagedorn states that undergo sequential binary emission of lighter resonances and stable hadrons till all the energy is exhausted. Binary collision between the particles during space-time evolution may regenerate the resonance thereby maintaining detailed balance. The production yield of (hyper)nuclei and exotic multistrange hypernuclear objects will be presented over a wide collision energy range from the AGS/BNL to the LHC/CERN. We find abundant antinuclei production and their reconstruction thus becomes feasible at the RHIC and LHC energies where the net baryon densities are relatively small. At center-of-mass energy of 8-20 GeV, relatively large baryon density and moderate strangeness provide the ideal energy regime for the observation of multi-strange hypernuclear objects.

Hypernuclei / **70**

Production of hypernuclei in Pb-Pb collisions at √sNN = 2.76 TeV with ALICE at the LHC

Author: Ramona Lea[1]

[1] *Universita e INFN (IT)*

Corresponding Author: ramona.lea@cern.ch

In high-energy heavy-ion collisions hyperon-baryon bound systems, called hypernuclei, can emerge from the hot and dense fireball region of the reaction.
Their production yield can be estimated employing two distinct models: they can be formed via the coalescence of nucleons and hyperons produced in the collision or they can be produced directly in the hadronisation process. The study of the production yield of hypernuclei at the LHC energy can help to distinguish between the two models.
Results on (anti-) hypertriton production in Pb–Pb collisions at √sNN = 2.76 TeV, obtained by ALICE at the LHC, are reported.
The (anti-) 3LH signal is extracted exploiting its mesonic decay (3
LH ⟶ 3He + π) , via the topological identification of secondary vertices and the study of the invariant mass distributions of (3He, π) pairs.
The (anti-) 3LH production yield will be presented and compared to stable nuclei and theoretical models. An assessment of (anti-) 3
LH lifetime will also be discussed.

Thermal models / 93

Hadronic effects on the hadron abundances in heavy ion collisions

Authors: Su Houng Lee[1]; Sungtae Cho[None]

[1] *Yonsei University*

Corresponding Author: sungtae.cho@kangwon.ac.kr

We present results from our recent investigation on the evolution of hadron abundances in heavy ion collisions. We study the production yields of hadrons with strangeness or charm quarks at the chemical freeze-out and their evolutions in the hadronic matter. The scattering cross sections with pions and rho mesons are studied in an effective Lagrangians to describe the dominant hadronic interaction during the hadronic stage of heavy ion collisions. We show that some hadron abundances may vary significantly and this result in return can tell us the lifetime of the hadronic phase in heavy ion collisions.

Quarkonia/Heavy Flavour / 60

Upsilon Production in Pb-Pb and p-Pb Collisions at Forward Rapidity with ALICE at the LHC

Author: Palash Khan[1]

[1] *Saha Institute of Nuclear Physics (IN)*

Corresponding Author: palash.khan@cern.ch

The ALICE apparatus at the LHC was designed and built to perform dedicated
studies of the Quark-Gluon Plasma (QGP), a strongly interacting QCD matter deconfined state, expected to be created in high energy heavy-ion collisions. In such collisions heavy flavours are produced at the very early stage of the interaction in the initial hard scattering processes and hence can be used to characterize the hot and dense medium. In particular the bottonium family was proposed as a thermometer of the deconfined medium. In ALICE, the Upsilon(1S) meson can be measured in its dimuon decay channel at forward rapidity (2.5 < y < 4.0).
In this talk, results on the Upsilon(1S) nuclear modification factor (RAA) in Pb-Pb collisions at a Nucleon-Nucleon c.m. energy of 2.76 TeV will be discussed and will be compared to the measurement at midrapidity by CMS and to theoretical predictions.

Quarkonia/Heavy Flavour / 68

Open Heavy Flavor Production in Heavy-ion Collisions from STAR

Author: Yifei Zhang[1]

[1] *University of Science and Technology of China*

Corresponding Author: ephy@ustc.edu.cn

(for the STAR Collaboration)
Recent RHIC measurements support that a strongly coupled nuclear matter with parton degree of freedom has been created in relativistic heavy-ion collisions. However, the thermalization of such a hot and dense medium is still unclear. Heavy quarks are expected to be created from initial hard scatterings. Their large masses are not easily affected by the strong interaction with QCD medium, they thus carry clean information from the system at early stage. The interaction between heavy quarks and the medium is sensitive to the medium dynamics, especially sensitive to the degree of the system thermalization. Therefore heavy quarks are suggested as ideal probes to quantify the properties of the strongly interacting QCD matter.

In this talk, we will present the STAR measurements of open charm hadron and its semileptonic decay electron (NPE) production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV. The centrality dependence of D-meson and NPE p_T spectra, nuclear modification factors will be presented. The elliptic flow of D^0 and NPE will also be shown. The comparison between D-meson and NPE, and the status of separating bottom and charm contributions in NPE analysis, will be discussed.

Hypernuclei / 77

Search for exotic hyper-matter and measurement of nuclei with ALICE at the LHC

Author: Benjamin Doenigus[1]

[1] *GSI - Helmholtzzentrum fur Schwerionenforschung GmbH (DE)*

Corresponding Author: benjamin.doenigus@cern.ch

The high collision energies reached at the LHC lead to significant production yields of light anti-nuclei and hyper-matter in proton-proton and, in particular, Pb-Pb collisions. The excellent particle identification capabilities of the ALICE apparatus, based on the specific energy loss in the Time Projection Chamber and time-of-flight measurement, allow for the detection of these rarely produced particles. Further the Inner Tracking System gives the possibility to separate primary nuclei from those coming from the decay of heavier systems. This offers the unique opportunity to search for exotica like the bound state of a Lambda and a neutron which would decay into deuteron and pion, or the bound states of two Lambda's.
The results of these searches will be compared to the production of light (anti-)nuclei and with the expectations from thermal and coalescence models.

Closing 1 / 164

eA

Closing 1 / 160

Theory summary: Quarks, Flow and Temperature in Spectra

Corresponding Author: tsbiro@rmki.kfki.hu

Closing 2 / 161

SQM2013: Experimental Summary

Corresponding Author: andrea.dainese@pd.infn.it

Closing 2 / 166

Next SQM

Closing 2 / 168

Closure

Corresponding Author: orlando.villalobos.baillie@cern.ch

128

Color reconnection and flow-like patterns in pp collisions.

Authors: Antonio Ortiz Velasquez[1]; Eleazar Cuautle Flores[2]; Guy Paic[2]; Ivonne Alicia Maldonado Cervantes[2]; Peter Christiansen[1]

[1] *Lund University (SE)*

[2] *Universidad Nacional Autonoma (MX)*

Corresponding Author: ivonne.alicia.maldonado.cervantes@cern.ch

Recent data collected at the LHC are confronted with the possible existence of flow in proton-proton collisions. Different Monte Carlo models are used to explain the multiplicity, transverse momenta distributions and other variables that allow characterize proton-proton events. In this work we present a work on the frame of PYTHIA 8 Monte Carlo model, showing that this event generator produces flow-like effects in events with multiple hard subcollisions due to color string formations between final partons from independent hard scatterings, the so called color reconnection. We present studies of different identified hadrons observables in proton-proton collisions at 7 TeV. Studies have been done both for minimum bias and multiciplity intervals in events with and without color reconnection to isolate the flow like effect. We observe this effect in the baryon to meson ratios, like Λ/K0s, which has an enhancement at intermediate transverse momentum, behaviour that seems to be effect of the color reconnection.

36

The influence of initial conditions on the final observables for heavy-ion collisions at RHIC energies

Author: Rudy Marty[1]

Co-authors: Elena Bratkovskaya [2]; Joerg Aichelin [3]; Wolfgang Cassing [4]

[1] *FIAS (Frankfurt, GERMANY)*

[2] *FIAS*

[3] *Unknown*

[4] *University of Giessen*

Corresponding Author: marty@fias.uni-frankfurt.de

Every dynamical description of heavy-ion collisions −whether based on hydrodynamics or on a parton cascade− starts out with the modeling of the ‘initial condition’, i.e. the state of the system after the first initial energetic collisions between target and projectile nucleons. Usually it is assumed that the whole system or at least the quark-gluon plasma comes to a thermal equilibrium after 1fm/c and then hydrodynamics can be employed.

We present a systematic study of the influence of the initial conditions on the final observables for heavy-ion reactions by investigating this reaction for different intial conditions with the novel molecular dynamics (MD) transport approach based on the the Nambu-Jona-Lasinio (NJL) model. The NJL Lagrangian whose parameters are adjusted to properties of free mesons and their decay constants allows for a description of the expansion of a quark-antiquark plasma whose constituents interact by potential and collisional interactions. It describes as well the transition of the plasma to the hadronic world.

For our comparison we use a ‘smooth’ initial conditions of the Glauber type as well as the ‘lumpy’ energy density profile from the microscopic PHSD (Parton-Hadron-String-Dynamics) transport approach which incorporates the hadronic and partonic interactions. For these different initial conditions we present the results for the transverse differential spectra dN/dpt and the elliptic flow v2 for Au+Au at RHIC energies. We analyse furthermore the origin of these differences and whether the experimental spectra allow for a conclusion about the structure of the initial conditions.

6

Azimuthal correlation of charm quark pair produced in heavy ion collision

Author: Mohammed Younus[1]

Co-author: Dinesh Srivastava [2]

[1] *Variable Energy Cyclotron Centre*

[2] *Variable Energy Cyclotron Centre, Kolkata*

Corresponding Author: younus.presi@gmail.com

It is known that heavy quarks are produced in pairs. There always exists a correlation in azimuthal angle in transverse momentum plane between such both the members in such pairs. The two quarks in a pair may lose different amount of energy while traveling through QGP and it is expected that the correlation of Q\bar{Q} will be altered considerably. Also in a completely different picture collective flow velocity of the medium can change the correlation of the heavy quark if heavy quark is assumed to be thermalized. Here we present the effect of charm quark energy loss (based on Wang-Huang_Sarcevic Model) on its correlation. The flow feature is shown using a naive model based on Cuautle-Paic model.

Summary:

The results for correlation are shown for different charm quark momentum regions and show a dependency on energy loss mechanisms and can be compared to the experimental data on charm quark azimuthal correlation if measured.

53

Study of b-jet tagging performance in ALICE

Author: Linus Feldkamp[1]

[1] *Westfaelische Wilhelms-Universitaet Muenster (DE)*

Corresponding Author: linus.feldkamp@cern.ch

Study of b-jet tagging performance in ALICE

Linus Feldkamp, for the ALICE Collaboration

Heavy quarks, produced in the early stage of heavy-ion collisions, are ideal probes to study the characteristics of the hot and dense deconfined medium (Quark-Gluon Plasma) formed in these collisions.
The energy loss of high energy partons interacting with the medium is expected to be larger for gluons than for quarks, and to depend on
the quark mass, with beauty quarks losing less energy than charm and light quarks.
A comparison of the modification of b-jets with that of light flavour or c-jets in Pb-Pb collisions, therefore, allows to investigate this energy loss mass dependence.
It may also allow to study the destination of the lost energy and possible modifications to b fragmentation in the medium.

In this poster we present a MC study of the b-jet tagging performance in ALICE for pp collisions at $\sqrt{s}$ = 7 TeV using different algorithms, all exploiting the long lifetime and high mass of B mesons to discriminate b-jets from jets from light partons.

37

Relativistic hydrodynamics on graphics processing units

Author: Jan Piotr Sikorski[1]

Co-authors: Joanna Porter-Sobieraj [1]; Marcin Slodkowski [1]; Piotr Krzyżanowski [1]; Przemysław Duda [1]; Sebastian Cygert [1]

[1] *Warsaw University of Technology (PL)*

Corresponding Author: jan.piotr.sikorski@cern.ch

Hydrodynamics calculations have been successfully used in studies of the bulk properties of the Quark-Gluon Plasma, particularly of elliptic flow and shear viscosity.
However, there are areas (for instance event-by-event simulations for flow fluctuations and higher-order flow harmonics studies) where further advancement is hampered by lack of efficient and precise 3D+1 program.
This problem can be solved by using Graphics Processing Unit (GPU) computing, which offers unprecedented increase of the computing power compared to standard CPU simulations.

In this poster, we present an implementation of 3D+1 ideal hydrodynamics simulations on the Graphics Processing Unit using Nvidia CUDA framework.

MUSTA-FORCE (multi stage, first order central, slope limited) scheme is employed in the simulations, delivering second order accuracy in both space and time.
Our implementation improves the performance by about 2 orders of magnitude compared to a single threaded program.
The algorithm tests of 3D+1 simulation with ellipsoidal and Hubble-like expansion are also presented.

90

Charm decay as a source of multistrange hadrons

Author: Michal Petran[1]

Co-authors: Jean Letessier [2]; Johann Rafelski [3]; Vojtech Petracek [1]

[1] *Czech Technical University (CZ)*

[2] *Laboratoire de Physique Theorique et Hautes Energies, Universite Paris 6, Paris 75005, France*

[3] *University of Arizona*

Corresponding Author: michal.petran@cern.ch

In Pb–Pb collisions at sN N = 2.76 TeV at LHC, a rather large number of charm–anti-charm quark pairs, Ncc ≡ dNcc /dy, is produced in initial hard parton collisions before the QGP phase emerges. Given Ncc , we predict yields of all charmed hadrons using statistical hadronization method. We use the experimental D0 meson pT -spectrum to estimate the range of charm abundance present at hadronization to be Ncc = 6 − 45 cc pairs. About 20% of charm is bound to strangeness and, as a consequence, charm decays contribute a significant fraction of multistrange hadron yields. Based on experimental decay data, symmetry principles and plausibility arguments, we prepare a complete charmed hadron decay table. The CHARM module adds charm decay hadron multiplicity into SHARE, the statistical hadronization model implementation we use. SHARE with CHARM utility uses Ncc as an additional fit parameter when analyzing hadron production in heavy–ion collisions. We quantify the charm hadron decay contributions in the final hadron yields. Up to 20% of φ, 15% of Ξ and 15% of Ω yield is produced directly by charm decays, whereas non–strange particles are less affected, e.g. less than 7% of π yield originates directly in a charm hadron decay.

82

Heavy meson interactions in a hadronic gas: chiral symmetry, unitarization and transport properties

Author: Daniel Cabrera[1]

Co-authors: Felipe Llanes-Estrada [2]; Juan Torres-Rincon [3]; Luciano Abreu [4]

[1] *Frankfurt University and FIAS*

[2] *Universidad Complutense de Madrid*

[3] *IEEC/CSIC and Universidad Complutense de Madrid*

[4] *Universidade Federal da Bahia*

Corresponding Author: cabrera@fias.uni-frankfurt.de

Charm and bottom transport coefficients in a light meson gas, such as is formed in the hadronic phase of Heavy Ion Collisions, are obtained within chiral perturbation theory and implementing constraints from heavy quark symmetry. By means of unitarization of the lowest order heavy-light meson scattering amplitudes, the D/B_0 and D/B_1 resonant states are dynamically generated in the isospin 1/2 channels in good agreement with experimental data, a feature that leads to a more efficient heavy flavor diffussion in the hadronic medium.

We discuss the temperature and momentum dependence of the friction and diffusion coefficients of heavy mesons in a transport approach, in a wide range of temperatures up to about $T \simeq 150$ MeV. A comparison with other recent results and implications for heavy meson spectrum observables in Heavy Ion Collisions are discussed.

51

Elliptic flow of heavy-flavour decay electrons at √sNN = 2.76 TeV with ALICE

Author: Andrea Dubla[1]

[1] *University of Utrecht (NL)*

Corresponding Author: andrea.dubla@cern.ch

Elliptic flow of heavy-flavour decay electrons at √sNN = 2.76 TeV with the ALICE detector

Andrea Dubla (Utrecht University) for the ALICE Collaboration

Heavy-quarks, i.e. charm and beauty, are mainly produced in hard scattering processes in the early stages of high energy nucleus- nucleus collisions, carrying informations on the full evolution of the medium. Therefore, they are suited to investigate the deconfined medium formed in such collisions, the Quark-Gluon-Plasma (QGP). One of the experimental observables that is sensitive to the interactions of heavy quarks with the medium and their degree of thermalization is the azimuthal distribution of particles in the plane perpendicular to the beam direction.

In this contribution we will present the elliptic flow v2 of electrons from the semi-leptonic decays of heavy-flavour hadrons at mid- rapidity with the ALICE detector for semi-central (20-40% centrality) Pb-Pb collisions at √sNN = 2.76 TeV. At low transverse momentum, the heavy-flavour v2 allows to probe the degree of thermalization of heavy quarks in the deconfined medium. At high transverse momentum it carries information on the dependence of energy loss on the in-medium path length of the heavy quarks. Comparisons with previous measurements obtained at lower collision energy at RHIC and with theoretical models will be presented as well.

52

Measurements of the correlation between electrons from heavy-avour hadron decays and light hadrons with ALICE at the LHC

Author: Elienos Pereira De Oliveira Filho[1]

[1] *Universidade de Sao Paulo (BR)*

Corresponding Author: elienos.pereira.de.oliveira.filho@cern.ch

Measurements of the correlation between electrons from heavy-avour hadron decays and light hadrons with ALICE at the LHC

Elienos Pereira de Oliveira Filho, for the ALICE Collaboration

Relativistic heavy-ion collisions are a unique tool to study the properties of the Quark-Gluon Plasma (QGP) in the laboratory. For this purpose, several observables have been measured with ALICE at the LHC, where heavy-ion collisions can be investigated at the
highest energies available to date.
Heavy quarks, i.e. charm and beauty, are a powerful probe in such experiments. Due to their large masses, they are produced in initial hard parton collisions, and they propagate through the hot and

dense medium created in the heavy-ion collision. One of the approaches to study heavy-quark production is to measure the electrons from
semi-leptonic decays of heavy-avour hadrons.
An important observable, in this context, is the two-particle correlation function in azimuth (Δφ) and in pseudorapidity (Δη) between electrons from heavy-avour hadron decays and light hadrons. The correlation close to Δφ = 0 and Δη = 0 is dominated by the "near-side" jet, where the electron and the associated hadron originate from the fragmentation of the same parton. The correlation around Δφ = π reects the recoil jet and, therefore, it should be sensitive to the properties of the medium.
In the case of pp collisions (√s = 2.76 TeV), the relative contributions from beauty and charm-hadron decays to the electron yield were extracted by comparing the measured Δφ distribution with Monte Carlo simulations. Indeed, due to the decay kinematics, the width of the near-side peak is larger for beauty than charm hadron decays.
In this poster, the correlation functions of electrons from heavy-avour hadron decays and light charged hadrons will be shown for pp (√s = 2.76 TeV), Pb-Pb (√sNN = 2.76 TeV), and p-Pb collisions (√sNN = 5.02 TeV).

169

Test

Author: Jozko Mrkvicka[1]

[1] *Koxurkovo*

Corresponding Authors: roman.lietava@cern.ch, roman.lietava@gmail.com

80

Strange meson spectral functions and cross sections in hot and dense nuclear matter

Author: Daniel Cabrera[1]

[1] *Frankfurt University and FIAS*

Corresponding Author: cabrera@fias.uni-frankfurt.de

We discuss updated results on the properties of strange mesons in nuclear matter at finite temperature from a chiral unitary approach in coupled channels, which incorporates the s- and p-waves of the kaon nuceon interaction. As a novelty, the in-medium scattering amplitudes and cross sections in several channels (such as Kbar N -> pi Sigma) are obtained in addition to the (off-shell) K and Kbar spectral functions and quasi-particle properties, which is of particular interest for microscopic transport evaluations of strangeness production and propagation in heavy-ion collisions.
A reminder of previous results and comparison to data from the HSD transport approach, relying on a G-matrix calculation of strange meson spectral functions within a meson-exchange model, is presented. Progress on our understanding of strange meson interactions with hadronic matter, in view of in-medium cross sections within the chiral unitary model, is discussed.