HK 36: Heavy-Ion Collisions and QCD Phases IX

Time: Wednesday 16:30–18:45 Location: J-HS H

Group Report HK 36.1 Wed 16:30 J-HS H

Two-particle azimuthal correlations as a probe of collective behaviour in deep inelastic *ep* scattering at HERA — •Dhevan Gangadharan for the ZEUS-Collaboration — Universitat Heidelberg, Heidelberg, Deutschland

Two-particle azimuthal correlations have been measured in neutral current deep inelastic ep scattering with virtuality $Q^2 > 5$ GeV^2 at a centre-of-mass energy $\sqrt{s} = 318$ GeV recorded with the ZEUS detector at HERA. The correlations of charged particles have been measured in the range of laboratory pseudorapidity $-1.5 < \eta < 2$ and transverse momentum $0.1 < p_{\mathrm{T}} < 5$ GeV and event multiplicities N_{ch} up to six times larger than the average $\langle N_{\mathrm{ch}} \rangle = 5$. The two-particle correlations are measured in terms of the angular observables $c_n\{n\} = \langle\langle \cos n(\varphi_1 - \varphi_2) \rangle\rangle$, where the harmonic n is between 1 and 4 and φ_i is the azimuthal angle of particle i. The correlations observed in HERA data do not indicate the kind of collective behaviour as recently observed at the highest RHIC and LHC energies in high multiplicity hadronic collisions. Available Monte Carlo models of deep inelastic scattering, tuned to reproduce the inclusive particle production, provide a qualitative description of the HERA data.

HK 36.2 Wed 17:00 J-HS H

CBM performance for strange hyperon flow measurements — •Oleksii Lubynets[1,2,3], Ilya Selyuzhenkov[1,4], and Viktor Klochkov[1,2] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Goethe Universität Frankfurt, Frankfurt am Main, Germany — [3]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [4]National Research Nuclear University (Moscow Engineering Physics Institute), Moscow, Russia

The main goal of the CBM experiment is to study highly compressed baryonic matter produced in collisions of heavy ions. SIS100 accelerator at FAIR will give a possibility to investigate the QCD matter at temperatures about 120 MeV and net baryon densities 5-6 times larger than a nuclei density. Strange hyperons produced in the dense phase of the heavy-ion collision provide information about the equation of state of the QCD matter. The measurement of their anisotropic flow is important for understanding the evolution of the QCD matter.

In this work the status of the CBM performance for strange particle anisotropic flow measurement is presented. Flow coefficients are calculated relative to the spectator plane estimated with the CBM Projectile Spectators Detector. Strange hyperons decay within the CBM detector volume and are reconstructed via their decay topology. Kalman Filter Particle Finder package is a very powerful tool, which allows to reconstruct decays with high efficiency. In the current work its simplified version, the KF Simple, is used to optimize selection criteria of the strange hyperon reconstruction and for CBM flow performance study.

HK 36.3 Wed 17:15 J-HS H

Recent results on higher moments of net-baryon distributions in Pb-Pb collisions from ALICE — •Mesut Arslandok for the ALICE-Collaboration — Physikalisches Institut Heidelberg

The fluctuations of conserved charges in ultrarelativistic heavy-ion collisions provide insights into the properties QCD phase diagram. At LHC energies there would be, for vanishing light quark masses, a temperature-driven genuine phase transition of second order between the hadron gas and the quark-gluon plasma. For realistic quark masses, however, this transition becomes a smooth cross over. Nevertheless, due to the small masses of current quarks one can still probe critical phenomena at the LHC energies, which can be confronted with the ab-initio LQCD calculations at vanishing baryon chemical potential.

In this contribution, the latest results will be presented on event-by-event analysis of net-baryon number fluctuation measurements in Pb-Pb collisions recorded by the ALICE Collaboration at the CERN LHC. The cumulants of net-proton distributions, as proxy to net-baryon distributions, up to third order will be discussed. The experimental results are confronted with corresponding signals from dynamical models and the dependence of fluctuation measurements on phase-space coverage of detected particles are addressed in view of the calculations from Lattice QCD (LQCD) and the Hadron Resonance Gas (HRG) model. Moreover, contributions from non-dynamical fluctuations such as those stemming from the baryon number conservation will be addressed.

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HK 36.4 Wed 17:30 J-HS H

The QCD phase diagram and baryon number fluctuations from Dyson-Schwinger equations — •Philipp Isserstedt[1], Michael Buballa[2], Christian S. Fischer[1], and Pascal J. Gunkel[1] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]Theoriezentrum, Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

In this talk we summarize our latest results on the QCD phase diagram and baryon number fluctuations using the nonperturbative framework of Dyson-Schwinger equations [1]. To this end, we solve a coupled set of these equations for the quark and gluon propagators of three-flavor QCD in Landau gauge. We present fluctuations and ratios thereof up to fourth order, ranging from vanishing chemical potential to the critical endpoint. In comparison with preliminary experimental data from the STAR collaboration for the skewness and kurtosis ratios, our results are compatible with a critical endpoint at large chemical potential and a freeze-out line that bends below it.

[1] P. Isserstedt, M. Buballa, C. S. Fischer, and P. J. Gunkel, Phys. Rev. D 100, 074011 (2019), arXiv:1906.11644

HK 36.5 Wed 17:45 J-HS H

Using spectators to probe anisotropic flow fluctuations in Pb-Pb collisions with ALICE at the LHC — •Lukas Kreis for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — Ruprecht-Karls-Universität Heidelberg

In heavy-ion collisions, the fluctuating phase-space distribution of the participant and spectator nucleons results in anisotropic flow fluctuations of the produced particles. Before the quark-gluon plasma is formed, the deflection of the spectators is imprinted in the initial energy-momentum distribution in the overlap zone. The pattern of flow fluctuations can be determined by comparing flow coefficients measured relative to the plane defined by the spectator deflection to those measured relative to the participant plane. These two measurements should exhibit the same behaviour for central and semi-central collisions and differ for peripheral, according to calculations, in which anisotropic flow fluctuations emerge from Gaussian fluctuations of initial spatial eccentricity. In this presentation, ALICE measurements of the anisotropic flow in Pb–Pb collisions relative to the spectator deflection are presented. The deflection is determined using the Zero Degree Calorimeter. Together with ALICE measurements of two and multi-particle cumulant methods this allows to probe flow fluctuations and their deviation from the Gaussian shape.

HK 36.6 Wed 18:00 J-HS H

Linearized kinetic description of non-equilibrium dynamics in pp and pA collisions — •Clemens Werthmann — Universität Bielefeld, Bielefeld, Deutschland

Momentum anisotropies caused by collective flow phenomena in HICs have been known to convey a rich amount of information on the collision geometry. In pp and pA collisions the collision area is too small - resulting in density gradients that are too large - for the well-understood hydrodynamic description of these anisotropies to be applicable. Instead, a microscopic description of the non-equilibrium dynamics has to be employed. Indeed, numerical simulations based on kinetic theory have reproduced the anisotropies, but they do not allow insight into the mechanisms of their emergence. This prompts attempts to employ analytical treatments of the kinetic theory description, which is highly nontrivial. In order to simplify the problem, the strategy presented in this talk is to apply an appropriate expansion scheme of the Boltzmann equation and then linearize in small anisotropic perturbations of the initial distribution on top of an isotropic Gaussian background.

HK 36.7 Wed 18:15 J-HS H

Fluid dynamics of heavy ion collisions with mode expansion — •Andreas Kirchner[1], Daniel Boness[1], Stefan Floerchinger[1], and Eduardo Grossi[2] — [1]Institut für Theoretische Physik, Heidel-

berg, Deutschland — [2]Stony Brook University, Stony Brook, USA

In this talk we present a way to describe a quark gluon plasma in its fluid dynamical regime with the self written Mathematica package FluiduM. We use a background-fluctuation splitting together with a mode expansion technique to solve the Israel Stewart type hydrodynamic equations of motion.

We are able to perform a systematic comparison of experimental data for pions, kaons and protons at LHC energies using the FluiduM code package.

HK 36.8 Wed 18:30 J-HS H

A hydrodynamical model for observed particle correlations in pp collisions — •Seyed Farid Taghavi — Technical University of Munich, Munich, Germany

The observed long-range correlations in pp collision in 2010 lead to an on-going debate about the collectivity in small systems. In the present talk, we introduce a semi-analytic hydrodynamical model to examine the applicability of hydrodynamics in small systems. We show that there is a lower bound for the rms radius of the system proportional to the inverse of the square root of the total energy in the transverse direction. By introducing a rather generic model for the initial state, we compare the outcome of our model with the experimental data. The model can describe the two-particle azimuthal correlation in pp collision. Moreover, it explains the multiplicity dependence of four-particle correlation, at least qualitatively, which has not been produced by other hydrodynamical models so far.

Based on: [arXiv: 1907.12140]