HK 65: Heavy-Ion Collisions and QCD Phases XIII

Time: Thursday 16:00–17:30 Location: HK-H1

HK 65.1 Thu 16:00 HK-H1

Temperature and net baryochemical potential dependence of η/s in a hybrid approach — •Niklas Götz[1,2] and Hannah Elfner[3,1,2] — [1]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany

In this work, the qualitative impact of the net baryochemical potential dependence of the shear viscosity to entropy density ratio η/s in hydrodynamical simulations is studied. The effect of a predicted non-constant $\eta/s(\mu_B)$ is largely unexplored in hydrodynamic simulations. Previous studies focus only on a temperature dependence or even only a constant effective shear viscosity. This work addresses this issue by studying qualitatively the effect of a generalized $\eta/s(T, \mu_B)$ in the novel hybrid approach SMASH-vHLLE, composed of the hadronic transport approach SMASH[1] and the (3+1)d viscous hydrodynamic code vHLLE[2]. In order to reduce the bias of the result on the equation of state used in the hydrodynamic part of the model, η/s is parameterized directly in the energy density and baryon number density. This work compares the impact of the density dependence for different system sizes and energies and constrains the behaviour of $\eta/s(T, \mu_B)$ by ruling out regions of the parameter space.

[1] https://github.com/smash-transport/smash
[2] https://github.com/yukarpenko/vhlle

HK 65.2 Thu 16:15 HK-H1

New developments in flow analyses with multiparticle $>$ correlations in ALICE and CBM — •Ante Bilandzic for the CBM-Collaboration — Technical University of Munich, Germany

Anisotropic flow measurements in small collision systems with multiparticle azimuthal correlations are not reliable, since correlation techniques are a precision tool only in an environment characterized by large multiplicities and large flow values. We present the first analytic results for combinatorial background in multi-particle azimuthal correlations, and demonstrate that for small multiplicities this contribution is not negligible. We show that the analytic solutions for the combinatorial background are universal as they can be written generically in terms of multiplicity-dependent combinatorial weights and marginal probability density functions of starting multivariate distribution. We conclude that the observed universality of flow measurements in pp, p–Pb and peripheral Pb–Pb collisions at LHC can be attributed solely to the interplay between nonflow correlations and combinatorial background, which always exhibits universal scaling as a function of multiplicity.

We present the feasibility study of using correlation techniques in flow analyses in the CBM experiment at FAIR. The first results for the flow harmonics estimated with multiparticle cumulants, $v_n\{k\}$, and the multiharmonic flow correlations obtained with symmetric cumulants, $\mathrm{SC}(m, n)$, are presented. We test the scaling of both statistical and systematical uncertainties for these observables in a fixed-target environment characterized by small multiplicities.

HK 65.3 Thu 16:30 HK-H1

SMASH as an afterburner: Advances in the non-equilibrium hadronic evolution — •Oscar Garcia-Montero — Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main, Germany

The hot medium created by colliding two heavy ions is a system which is trying against all odds to thermalize. For this reason, we focus on the non-equilibrium dynamics of the late hadronic stage of the fireball. More specifically, two recent developments on the physics of the afterburner, using the code SMASH. First the role of multi-particle reactions in the late stages of heavy-ion collisions are demonstrated to be significant for the final deuteron [1] and proton [2] abundances at intermediate to high beam energies.

Additionally, we present a consistent photon production calculation from hadronic cross sections, including bremsstrahlung and 2-to-2 reactions [3]. Using the hadronic transport approach SMASH as the afterburner for the hadronic stage at RHIC and LHC energies, we find a significant increase in the calculated momentum anisotropies of these photons due to microscopic non-equilibrium dynamics. Non-equilibrium dynamics enhance the photon v_2 below $p_\perp \approx 1.5$ GeV.

[1] Jan Staudenmaier, D. Oliinychenko, J. M. Torres-Rincon, and H. Elfner, Phys. Rev. C 104, 034908 (2021)
[2] O. Garcia-Montero, Jan Staudenmaier, A. Schäfer, J. M. Torres-Rincon, abd H. Elfner, arXiv:2107.08812
[3] A. Schäfer, O. Garcia-Montero, J-F. Paquet, H. Elfner, and C. Gale. arXiv: 2111.13603

HK 65.4 Thu 16:45 HK-H1

Precision hydrodynamic predictions for particle production in isobar collisions at RHIC — •Andreas Kirchner[2], Federica Capellino[1], Stefan Floerchinger[2], Giuliano Giacalone[2], and Eduardo Grossi[3] — [1]Physikalisches Institut Heidelberg — [2]ITP Heidelberg — [3]IPhT Saclay

The STAR collaboration has recently released high precision measurements of soft particle production in Ru+Ru and Zr+Zr collisions permitting us to perform precision tests of hydrodynamic models of the quark-gluon plasma (QGP). In this contribution, we discuss hydrodynamic results for particle production in isobar collisions where we achieve the same precision reached in the experimental data. Our approach relies on a background-fluctuation splitting of the equations of hydrodynamics. We decompose the QGP as an event-averaged azimuthally-isotropic background plus an event-by-event fluctuation. We show that the leading contribution to the average final-state spectra are obtained from the 1+1D evolution of the isotropic background, which is very fast to run. We use, hence, FluiduM, a new solver for the 1+1D evolution of the QGP, to compute predictions for particle spectra, yields and average transverse momenta of identified hadrons. Looking at ratios of quantities between Ru+Ru and Zr+Zr systems, we find that they are insensitive to viscosities and other medium parameters. They are instead driven by initial-state effects driven mainly by the larger neutron skin of 96Zr.

HK 65.5 Thu 17:00 HK-H1

Elliptic flow of pions, kaons and protons relative to the spectator plane measured with ALICE at the LHC — •Michael Rudolf Ciupek[1,2], Lukas Kreis[1,2], and Ilya Selyuzhenkov[2] for the ALICE-Collaboration — [1]Physikalisches Institut, Heidelberg, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

In relativistic heavy-ion collisions, the shape of the initial energy density in the overlap region of the colliding nuclei is asymmetric and fluctuates. Due to interactions, these are transferred to the momentum distribution of particles in the final state which is quantified by the flow coefficients v_n. Thermodynamic expansion of the quark-gluon plasma (QGP) results in a specific particle mass dependence of the v_n coefficients as a function of the transverse momentum. The measurements of the v_n relative to the spectator plane is of special interest, since the spectators decouple very early in the collision. Comparison of the v_n measured relative to the participant and that wrt. the spectator planes with the corresponding eccentricities allow constraining the initial state models. The particle type (mass) dependence of these differences is sensitive to the viscous effects in the QGP expansion.
In this talk, the ALICE measurements of the v_2 for pions, kaons, and protons with respect to the spectator plane in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ and 5.02 TeV are presented. Results are compared with v_2 extracted from two and four-particle cumulants. The spectator plane is reconstructed using the ALICE Zero Degree Calorimeters. The particle identification is performed using a Bayesian approach.

HK 65.6 Thu 17:15 HK-H1

Application of the Three-fluid Hydrodynamics-based Generator THESEUS to CBM. — •Elena Volkova, Hans Rudolf Schmidt, and Viktor Klochkov for the CBM-Collaboration — Eberhard Karls Universität Tübingen

The Compressed Baryonic Matter experiment (CBM) aims to study the area of the QCD phase diagram at high net baryon densities and moderate temperatures. It is predicted by Three-fluid Hydrodynamics-based Event Simulator (THESEUS) that one of the signatures of phase transition is a change in shape of the mid-rapidity curvature and yield.

In this contribution we will present CBM performance for proton rapidity- transverse mass spectra. The results are obtained for Au+Au

collisions at $\sqrt{s_{NN}}$ = 2.7 - 4.9 GeV/c produced by THESEUS model. CBM detector response is simulated with the GEANT3 engine and reconstruction is done using the CbmRoot framework. Protons are identified with Time-of-Flight technique using 2 different approaches. Obtained spectra are corrected for detector biases using the UrQMD event generator. Results are compared with simulated values and sources of systematic biases are discussed.