HK 25: Heavy-Ion Collisions and QCD Phases VI

Time: Wednesday 14:00–16:00 Location: J-HS G

HK 25.1 Wed 14:00 J-HS G

Exploring the initial conditions of HIC beyond the boost invariant approximation — •Pragya Singh — University Of Bielefeld, Bielefeld, Germany

The pre equilibrium stage of Heavy-Ion collision is well described by the Color Glass Condensate (CGC), an effective theory of high energy QCD, which claims the existence of the Glasma. Within the CGC framework, a plethora of solutions for understanding the Glasma, are based on shock wave limit, where the Lorentz contracted, longitudinal extent of the fast-moving nuclei are considered to be infinitesimally thin. In order to understand the structure and the dynamics of the longitudinal direction of the fireball and to get the nontrivial rapidity dependent observables, one has to go beyond the boost invariant approximation. This talk mainly focusses on how the assumption of infinitesimally thin shock waves can be relaxed by solving the discretized 3+1 Dimensional Yang-Mills equation in classical statistical real-time lattice simulations.

HK 25.2 Wed 14:15 J-HS G

Relativistic kinetics of a BEC with inelastic processes — •Hendrik van Hees[1], Richard Lenkiewicz[1], Alex Meistrenko[1], Kai Zhou[2], Zhe Xu[3] und Carsten Greiner[1] — [1]Institute for Theoretical Physics, Goethe University, Frankfurt/Main — [2]Frankfurt Institute of Advanced Studies, Frankfurt/Main — [3]Tsinghua University Beijing

Motivated by the Color Glass Condensate model for the early stages of ultrarelativistic heavy-ion collisions, we investigate the time evolution of a Bose Einstein Condensate (BEC), including both elastic $2 \to 2$ and inelastic (particle-number changing) $2 \leftrightarrow 3$ processes. Employing a simple model with constant cross sections we solve the Boltzmann equation by numerically integrating the collision term, implementing the principle of detailed-balance. It is found that only for tiny inelastic cross sections in comparison to the elastic ones, $\sigma_{23}/\sigma_{22} \ll 1$, a transient BEC is formed for a short time, before the time evolution converges to the expected thermal equilibrium without a BEC [1].
Supported by DFG through CRC-TR 211.

[1] R. Lenkiewicz et al, Phys. Rev. D **100**, 091501(R) (2019)

HK 25.3 Wed 14:30 J-HS G

Charged particle production as a function of multiplicity measured with ALICE at the LHC — •Mario Krüger for the ALICE-Collaboration — Institut für Kernphysik Frankfurt

Heavy-ion collisions at the Large Hadron Collider facilitate the study of the Quark-Gluon-Plasma in the laboratory. Complementary measurements of smaller collision systems have shown that already for p–p collisions signs of collectivity can be observed. The great challenge for modern Monte-Carlo event generators is to describe particle production in a consistent way for all of the collision systems.

One sensitive observable to probe the particle production mechanisms implemented in these models is the correlation between transverse momentum spectra and event multiplicity. In this talk, we report the ALICE measurement of unidentified charged-particle p_{T} spectra obtained using a 2d-unfolding technique. We present derived quantities of these spectra and compare different collision systems and energies.

Supported by BMBF and the Helmholtz Association.

HK 25.4 Wed 14:45 J-HS G

Probing the path-length dependence of jet energy loss with correlation functions in JEWEL — •Luisa Bergmann for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

In relativistic heavy-ion collisions, a deconfined medium with high energy density is created, the quark-gluon plasma. Amongst other observables, jets – originating from primordial hard scatterings – act as useful probes for the properties of this medium. As the initial partons traverse the quark-gluon plasma, they lose energy by interacting with the constituents of the medium. The study of this so called "jet quenching" yields insight into the properties of the medium.

This talk focuses on the study of the path-length dependence of energy loss via correlation functions. By analyzing the angular dependence of the distribution of charged hadrons in two-particle and multi-hadron correlations, one obtains the informations in a statistical approach which is independent of particular jet definitions and sensitive in regions with high background contributions. To provide a well formed basis for future data analyses, the analysis of correlations is first performed with models, in particular by employing JEWEL. The usage of Monte-Carlo event generators offers the possibility to gain knowledge about the interaction processes in a controlled environment, which can then be used to understand structures in real data. This information ultimately helps to constrain the models of energy loss and of interactions of colored probes and media.

HK 25.5 Wed 15:00 J-HS G

Nuclear modification of charged-particle production with the ALICE experiment — •Youssef El Mard Bouziani for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at the LHC is designed to study the properties of the hot and dense deconfined QCD medium, the Quark-Gluon Plasma, believed to be created in high-energy heavy-ion collisions. The interaction between quarks or gluons and the medium can be investigated by comparing the charged-particle production in Pb-Pb collisions and a corresponding reference measurement in pp collisions. This comparison is expressed by means of the nuclear modification factor R_{AA}, the ratio of the yield in AA collisions and the yield in pp collisions scaled by the number of binary collisions.

In this talk, we present the nuclear modification factor of charged particles based on Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV recorded in 2015 and 2018 with special focus on high p_{T}. This analysis of R_{AA} furthermore draws upon the improved precision of the charged-particle production in pp collisions at $\sqrt{s} = 5.02$ TeV measured in 2017.

Supported by BMBF and the Helmholtz Association.

HK 25.6 Wed 15:15 J-HS G

Jet-hadron correlations in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV — •Jiyoung Kim — Physikalisches Inistitut, Heidelberg, Germany

An object which travels faster than the speed of sound in a medium generates a conical pressure wave front, called 'Mach shock wave'. Such shock wave can be produced by hard-scattered partons, which fragment into clusters of hadrons known as 'jets', which propagate through the Quark-Gluon Plasma (QGP). The jets interact with the QGP and lose a part of their energy in the propagation. The transfered energy from the jets to the medium leads to a increase of soft particle production. An angular correlation analysis allows us to improve our understanding of the interaction between the QGP and jets as well as to enable to search Mach shock wave generated in the medium.

In this presentation, we show angular correlations of inclusive hadrons and identified protons with respect to the axis of charged jets produced in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV in the ALICE detector. As proton abundance in the medium is relatively higher than that in the jet fragmentation, when we study both the jet-hadron and the jet-proton correlation, it allows us to compare signals which have different amount of jet fragments in the correlation functions. Moreover, in order to enhance possibility to search the Mach shock signal, we studied additional hadron-hadron correlation only around the axis of quenched jet in simulation and in the data analysis. Those results are also presented in this talk.

This work is supported by BMBF and HGS-HIRe.

HK 25.7 Wed 15:30 J-HS G

Two-particle correlations with high-$\mathbf{p_{\mathrm{T}}}$ Λ baryons and K^0_S mesons in pp collisions at ALICE — •Lucia Anna Husova for the ALICE-Collaboration — Westfälische Wilhelms Universität, Münster, Germany

Due to the high particle multiplicities produced in Pb-Pb collisions, low-energy jets are difficult to reconstruct using standard jet algorithms. Two-particle correlations in $\Delta\eta$ and $\Delta\varphi$ can instead be used to study jets, their properties and their particle composition. In this work, two-particle correlations between a high-momentum K^0_S meson, Λ baryon, or $\bar{\Lambda}$ baryon (V^0s) and charged hadrons are used to study strange particle production in jets. Recent ALICE results on the production of strange particles in small systems (pp and p-Pb collisions)

reveal the possibility that similar strange quark production mechanisms could be present in all collision systems. Thus the per-trigger yields of the associated hadrons were studied on both the near-side and away-side of the V^0-h and h-V^0 correlation functions as a function of the transverse momenta of the trigger and associated particles as well as the event multiplicity in pp collisions at $\sqrt{s} = 13$ TeV collected with the ALICE experiment at the LHC. Moreover the h-h correlations were used as basis for the per-trigger yield ratios, which were compared to different MC generators.

HK 25.8 Wed 15:45 J-HS G

Non-equilibrium evolution of Jets in the QGP medium — •Ismail Soudi — Bielefeld University

During high-energy Heavy-Ion collisions a dense medium of deconfined quarks and gluons is formed. One important evidence of the quark-gluon plasma creation is the suppression of high transverse-momentum jets.

I will discuss how we study the non-equilibrium evolution and the chemical equilibration of these jets, using an effective kinetic theory of QCD. Applying what we learn about Jets or high-pT particles, we can explore the non-equilibrium evolution of the medium.