HK 21: Heavy-Ion Collisions and QCD Phases III

Time: Tuesday 15:45–17:15 Location: HBR 62: EG 03

HK 21.1 Tue 15:45 HBR 62: EG 03

Anomalous transport phenomena on the lattice — Bastian Brandt, Gergely Endrodi, •Eduardo Garnacho-Velasco, and Gergely Markó — Bielefeld University, Bielefeld, Germany

We study the Chiral Separation Effect (CSE) and Chiral Magnetic Effect (CME) using lattice QCD simulations with improved staggered fermions. We present the first continuum extrapolated result of the CSE conductivity in QCD with physical quark masses as a function of temperature, revealing a severe suppression of this effect at low temperatures. In addition, we discuss several subtleties that arise on the study of CSE on the lattice. We also shed light on the equilibrium interpretation of the CME, clarifying the expected vanishing current in this setup, and how to reconcile this with former lattice QCD results by emphasizing the importance of the discretization of the currents used.

HK 21.2 Tue 16:00 HBR 62: EG 03

The Chiral Magnetic Effect in QCD with a non-uniform magnetic background — •Adeilton Dean Marques Valois, Eduardo Garnacho-Velasco, Gergely Endrodi, Bastian Brandt, and Gergely Markó — Bielefeld University, Bielefeld, Germany

We explore the impact of a non-uniform magnetic field background on the Chiral Magnetic Effect (CME) in QCD using lattice simulations with dynamical staggered quarks at the physical point. We show that, in the presence of magnetic field gradients, the system develops a localized vector current density along the direction of the field, which integrates to zero in the full volume. This demonstrates that the total CME-conductivity vanishes in QCD at equilibrium, even though steady currents can exist locally. Our primary observable is the leading-order coefficient of the vector current in a chiral chemical potential expansion. We extrapolate this observable to the continuum limit and discuss possible implications of our findings to heavy-ion physics.

HK 21.3 Tue 16:15 HBR 62: EG 03

J/ψ measurements with machine learning and Kalman filter techniques with ALICE at the LHC — •Pengzhong Lu — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — University of Science and Technology of China, Hefei, China

Quarkonium production offers an effective way to study the properties of the quark-gluon plasma (QGP) created in ultra-relativistic heavy-ion collisions. While the prompt J/ψ production provides information on suppression and (re-)generation mechanisms in the QGP, the non-prompt J/ψ component (from b-hadron decays) allows one to study heavy quark energy loss in the medium. J/ψ meson production measurements in pp collisions, besides providing a reference for the corresponding measurements in p–Pb and Pb–Pb collisions, are also crucial to better understand quantum chromodynamics.

In this talk, the performance of the combined usage of KFParticle and machine learning (ML) for the measurement of prompt and non-prompt J/ψ production will be presented. The KFParticle package, based on the Kalman Filter algorithm, shows good performances in the reconstruction of particle decays. Combining it with ML techniques will significantly improve the signal reconstruction efficiencies and signal-to-background ratios. Results from this study in ALICE Run 3 pp collisions at $\sqrt{s}$ = 13.6 TeV, based on the data collected in 2022, will be shown.

HK 21.4 Tue 16:30 HBR 62: EG 03

Mid-rapidity J/ψ production as a function of multiplicity in p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with ALICE — •Tabea Eder for the ALICE Germany-Collaboration — Institut für Kernphysik, Universität Münster

ALICE results from LHC Run 1 data on the charged-particle multiplicity dependence of the inclusive normalized J/ψ production, both at mid-rapidity, indicate a stronger than linear increase for proton-lead collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV. The corresponding ALICE results on proton-proton collisions at $\sqrt{s}$ = 13 TeV provide a clearer picture of a stronger than linear increase.

This behaviour has been associated with auto-correlation effects in PYTHIA8 studies on proton-proton collisions. Amongst others, this has been achieved by differentiating between different J/ψ production mechanisms for the multiplicity dependent J/ψ production. One of these mechanisms is the weak decay of b-flavoured hadrons, leading to production of non-prompt J/ψ. In data, these can be distinguished by their displaced vertex from prompt J/ψ, which are produced directly in the initial hard collision.

In this talk the multiplicity dependent inclusive J/ψ production is presented for p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with improved statistics, which is needed to clarify the previous results and is achieved by using ALICE data from LHC Run 2. In addition for the first time a look into the multiplicity dependence of prompt and non-prompt J/ψ production in p–Pb collisions at ALICE is presented.

HK 21.5 Tue 16:45 HBR 62: EG 03

Multiplicity dependence of prompt and non-prompt J/ψ production in pp collisions with ALICE — •Gauthier Legras for the ALICE Germany-Collaboration — Institut für Kernphysik, Universität Münster

J/ψ production involves a hard scale for the creation of the charm-anticharm pair, and a soft scale for its hadronization. Correlating it with the multiplicity, mainly produced by soft processes, in small systems allows to investigate the interplay between hard and soft scales. A stronger-than-linear multiplicity dependence of inclusive J/ψ in pp collisions was found in previous ALICE publications, but the main reason was not yet clearly identified, justifying the need for additional studies investigating its origin. For example, there could be different contributions between prompt (produced directly in the collision) and non-prompt (coming from the decay of beauty hadrons) J/ψ. Additionally, the multiplicity can be separated in different azimuthal regions relative to the J/ψ, and, in each region, different effects for particle production, due to correlation with the presence of a prompt or non-prompt J/ψ, could be isolated.

This study aims at determining the multiplicity dependence, the multiplicity being measured either inclusively at midrapidity or in three azimuthal regions, of prompt and non-prompt J/ψ production pp collisions at $\sqrt{s}$ = 13 TeV, through its decay to an electron-positron pair at midrapidity. The rejection of background and separation between both J/ψ topologies is done with Boosted Decision Trees through the study of displaced decay vertices.

HK 21.6 Tue 17:00 HBR 62: EG 03

Jet-hadron correlations in PbPb collisions at $\sqrt{s_{\rm NN}}$ =5.02 TeV with ALICE — •Luisa Bergmann for the ALICE Germany-Collaboration — Physikalisches Institut, 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.

By analyzing the angular correlations of jets with charged hadrons, one obtains information about the energy loss of jets in the medium. The study of these correlation functions for different orientations of the jet to the event plane allows for a measurement of the energy loss which is sensitive to the in-medium path-length of the jet. In this talk, the current status of a study of event plane dependent jet-hadron correlations with data collected by the ALICE experiment in PbPb collisions at $\sqrt{s_{\rm NN}}$ =5.02 TeV is presented.