HK 32: Heavy-Ion Collisions and QCD Phases VI

Time: Tuesday 17:30–19:00 Location: HBR 62: EG 03

Group Report HK 32.1 Tue 17:30 HBR 62: EG 03

Non-perturbative insights into the spectral properties of QCD within the chiral crossover region — •Peter Lowdon[1], Owe Philipsen[1], Olaf Kaczmarek[2], Dibyendu Bala[2], and Tristan Ueding[2] — [1]Institut für Theoretische Physik, Goethe-Universität, Germany — [2]Fakultät für Physik, Universität Bielefeld, Germany

Determining the type of excitations that can exist in a thermal medium is key to understanding how hadronic matter behaves at extreme temperatures. Here I report on a recent approach which utilises the non-perturbative constraints imposed by causality. By analysing finite-temperature lattice QCD data for spatial correlators of pseudo-scalar mesons comprised of light-light, light-strange, and strange-strange quarks, we find evidence for the existence of distinct low-energy stable particle-like excitations, so-called thermoparticles. These excitations are shown to be present around the chiral crossover region, and correspond to the collisionally-broadened vacuum ground states, which for the light-light and light-strange channels are the pion and kaon. Overall, these findings suggest that at high temperatures light pseudo-scalar mesons in QCD still have a bound-state-like structure.

HK 32.2 Tue 18:00 HBR 62: EG 03

Spectral Reconstruction with Gaussian Process Regression — •Jonas Turnwald[1], Julian M. Urban[2,3], and Nicolas Wink[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Center for Theoretical Physics, Massachusetts Institute of Technology — [3]The NSF AI Institute for Artificial Intelligence and Fundamental Interactions

In order to understand the dynamics of QCD, knowledge about non-perturbative real-time correlation functions is necessary. These correlation functions can be accessed by reconstructing the spectral function from Euclidean data. Since this is an ill-conditioned problem, sophisticated techniques are necessary to ensure reliable results.

In this talk, we will present a method facilitating Gaussian Process regression for reconstructing spectral functions. Additionally, we will introduce a Python package that allows for an immediate implementation of this method for different linear inverse problems.

As an illustration, we present the reconstruction of different spectral functions and compute the thermal photon rate of the quark-gluon plasma.

HK 32.3 Tue 18:15 HBR 62: EG 03

Heavy-quark distribution function via a Maximum Entropy approach — •Federica Capellino[1], Andrea Dubla[2], Stefan Floerchinger[3], Eduardo Grossi[4], Andreas Kirchner[5], and Silvia Masciocchi[1,2] — [1]Physikalisches Institut Heidelberg, Heidelberg, Germany — [2]GSI, Darmstadt, Germany — [3]Theoretisch-Physikalisches Institut Universität Jena, Jena, Germany — [4]Università di Firenze, Sesto Fiorentino, Italy — [5]Institut für Theoretische Physik Heidelberg, Heidelberg, Germany

Heavy quarks (i.e. charm and beauty) are powerful tools to characterize the quark-gluon plasma (QGP) produced in heavy-ion collisions. They are initially produced out of kinetic equilibrium via hard partonic scattering processes. In this work, we first show that a fluid-dynamic approach can be applied to study the dynamics of charm quarks in the QGP and describe their relaxation towards kinetic equilibrium. Furthermore, we propose a description of the heavy-quark distribution function out of equilibrium via a Maximum Entropy method. This approach relies on the assumption that the distribution function maximizes a functional of the entropy current in any reference frame and does not require the distribution function to be close to local kinetic equilibrium. This description can be used to construct the momentum distribution of heavy-flavor hadrons at freeze-out, including consistently the impact of out-of-equilibrium corrections on the freeze-out surface.

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HK 32.4 Tue 18:30 HBR 62: EG 03

Ω_c^0 production in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE — •Tiantian Cheng for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Central China Normal University, Wuhan, China

Recent measurements of the production of charm hadrons at midrapidity in pp collisions at $\sqrt{s} = 5.02$ and 13 TeV showed that baryon-to-meson yield ratios are significantly larger than those measured in e^+e^- collisions for different charm-baryon species. These observations suggest that the charm fragmentation fractions are not universal and that the baryon-to-meson ratios depend on the collision systems.

Currently, a significant limitation to measurements of strange-charm baryon Ω_c^0 production is the absence of precise branching ratio (BR) measurements. In this talk, the new measurement of the inclusive p_T-differential cross section times branching ratio of the Ω_c^0 baryon measured in the decay channels $\Omega_c^0 \to \Omega^- e^+ \nu_e$ and $\Omega_c^0 \to \Omega^- \pi^+$ in pp collisions at $\sqrt{s} = 13$ TeV will be reported, together with the fraction $\mathrm{BR}(\Omega_c^0 \to \Omega^- e^+ \nu_e)/\mathrm{BR}(\Omega_c^0 \to \Omega^- \pi^+)$. The final result will be compared with theoretical calculations and experimental measurements from other Collaborations.

HK 32.5 Tue 18:45 HBR 62: EG 03

Charm quark thermalization in the quark gluon plasma at RHIC — •Rossana Facen for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

Hadrons containing heavy quarks, i.e. charm or beauty, are unique probes to study the properties of the hot and dense QCD medium produced in heavy-ion collisions, the quark-gluon plasma (QGP). Due to their large masses, heavy quarks are produced at the initial stage of the collision, almost exclusively via hard partonic scattering processes. Therefore, they experience the full collision history propagating through the QCD medium and interacting with its constituents. These interactions may lead heavy quarks to thermalize within the QGP. While various evidences supporting the thermalization of charm quarks at the LHC have been collected in recent years, the thermalization process highly depends on the colliding system and energy. In this study we focus on the possible thermalization of charm quarks at RHIC in Au-Au collisions at a center-of-mass energy of $\sqrt{s_{\mathrm{NN}}} = 200$GeV. The local thermalization of charm quarks is examined using a fluid-dynamic approach, describing charm quarks as part of the QGP medium itself. The output of our analysis is then compared to the available experimental results of STAR collaboration. This work is funded via the DFG ISOQUANT Collaborative Research Center (SFB 1225).