HK 3: Heavy Ion Collisions and QCD Phases II

Zeit: Montag 16:45–19:00 Raum: F 3

Gruppenbericht HK 3.1 Mo 16:45 F 3

Electromagnetic probes of hot and dense matter produced in Au+Au collisions at $E_{\mathbf{beam}} = 1.23A$ GeV. — •Szymon Harabasz for the HADES-Collaboration — TU Darmstadt

Properties of hot and dense QCD medium formed in heavy-ion collisions can be extracted directly from its emissivity in electromagnetic sector. Excess of the low-mass lepton pairs has been measured in such collisions in energy regimes from SIS18 up to top RHIC. Substantial medium effects on light vector mesons is attributed to their coupling to baryons and anti-baryons.

HADES has contributed to this study in moderate temperature but high density region of the QCD phase diagram by measuring lepton pairs production in N+N, N+A, A+A, π+N and π+A at the SIS18 accelerator in GSI. The strong non-linear system size dependence of the excess yield over the experimentally established "cocktail" has been previously extracted from the C+C and Ar+KCl runs.

In this presentation an overview of the results on electromagnetic probes from high statistics Au+Au at $E_{\mathrm{beam}} = 1.23A$ GeV data will be provided. Virtual photon spectra will be confronted with results of other experiments as well as with available model predictions. The understanding of the emerging physical implications can be refined by looking at direct photon production and virtual photon flow. EM transitions of baryonic resonances measured directly in pion-induced reactions are pivotal input to model calculations.

This work has been supported by VH-NG-823, Helmholtz Alliance HA216/EMMI, GSI, HGS-HIRe and H-QM.

HK 3.2 Mo 17:15 F 3

Low-Mass Dielectron Measurements in pp, p–Pb and Pb–Pb Collisions with ALICE — •Theo Bröker for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The measurement of electron-positron pairs (dielectrons) in the low invariant mass region allows to study the vacuum and in-medium properties of light vector mesons. Additionally, dielectrons from semileptonic decays of correlated heavy quark mesons carry information on the heavy-flavour production in the different collision systems. To quantify modifications of the dielectron production in Pb–Pb collisions, measurements in pp collisions serve as a reference, while the analysis of p–Pb collisions allows to disentangle cold from hot nuclear matter effects. During RUN1 at the LHC, studies of dielectron production in pp, p–Pb and Pb–Pb collisions have been performed.
In this talk, we present the dielectron invariant mass and transverse momentum distributions in pp collisions at $\sqrt{s} = 7$ TeV, p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV and Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV.
Supported by BMBF.

HK 3.3 Mo 17:30 F 3

Constraining HF production mechanisms with dielectrons — •Anisa Dashi for the ALICE-Collaboration — Technische Universität München, Exzellenzcluster Universe, Boltzmannstr. 2, D-85748 Garching

The continuum of electron-positron pairs, produced in heavy ion collisions, provides an excellent probe of quark-gluon plasma (QGP) formation. Since dielectron pairs are produced by different processes at all stages of the collision, their invariant mass spectrum contains various contributions, e.g. the intermediate mass region (1.2 to 2.8 GeV/c) is dominated by correlated semileptonic decays of open heavy flavour. From modifications of this region one can gain information about the effects of QGP on heavy quarks. This requires first, however, a good understanding of the relevance of the various heavy quarks production mechanisms. Heavy quarks are produced in leading order back to back through flavour creation in the initial hard scattering processes of the collision, but also higher order processes like flavour excitation and gluon splitting contribute to their production. This talk presents Monte Carlo simulation studies which aim to the separation of the different heavy flavour production mechanisms exploiting their different angular correlation in order to better understand their contribution to the dielectron mass spectrum. The analysis is performed for proton-proton collisions at 7 TeV, since a study of dielectrons in these collisions provides a crucial reference for the heavy ion data.

This work is supported by BMBF-FSP 202 and the Excellence Cluster Universe.

HK 3.4 Mo 17:45 F 3

Spectral Functions from the FRG beyond the Local Potential Approximation — •Alexander Stegemann[1], Ralf-Arno Tripolt[2], Lorenz von Smekal[3], Dirk-Hermann Rischke[1], and Jürgen Eser[1] — [1]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität Frankfurt am Main, Germany — [2]European Center for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), Trento, Italy — [3]Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, Germany

The Functional Renormalization Group (FRG) represents a powerful non-perturbative method in order to describe strongly interacting theories like Quantum Chromodynamics (QCD) at finite temperature and chemical potential. Furthermore, it allows for an analytic continuation from imaginary to real time on the level of the flow equations. By this way, it is possible to calculate real-time quantities like spectral functions.

We apply this method to the two-flavour Quark-Meson Model (QMM) in order to study the chiral phase transition as well as mesonic spectral functions. In the Local Potential Approximation (LPA), which is the lowest order truncation of the derivative expansion, discrepancies between the pion pole and curvature masses are observed. We present calculations in LPA′, which incorporates scale-dependent wave function renormalization factors, and discuss their influence on the phase diagram as well as on the mesonic spectral functions.

HK 3.5 Mo 18:00 F 3

Non-equilibrium dilepton production in hadronic transport approaches — •Jan Staudenmaier[1,2], Janus Weil[2], and Hannah Petersen[1,2,3] — [1]Goethe Universität Frankfurt — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenforschung

In this talk the non-equilibrium dilepton production from a hadronic transport approach (SMASH) is presented. The dilepton emission from the hadronic stage is of interest for current HADES results measured at GSI in the beam energy range from 1.25 - 3.5 GeV. Also at high collision energies (RHIC/LHC) the later dilute stages of the reaction are dominated by hadronic dynamics.

First, the employed hadronic transport approach called SMASH (=Simulating Many Accelerated Strongly-interacting Hadrons) is introduced. The main contribution to the dilepton spectra in the low energy regime of GSI/FAIR/RHIC-BES originates from resonance decays. Treatment and results of the dilepton production with SMASH are shown, together with a comparison to HADES data.

Furthermore, the possibility of employing the non-equilibrium dilepton production from a hadronic transport approach combined with a hydrodynamic approach (hybrid model) to describe spectra for high collision energies (RHIC/LHC) is explored.

HK 3.6 Mo 18:15 F 3

Elliptic flow of virtual photons — •Dominique Dittert for the HADES-Collaboration — TU Darmstadt

The HADES at SIS18 (GSI, Darmstadt) investigates strongly interacting matter at high net-baryon densities and moderate temperatures, which resembles properties of QCD matter as they might exist in the interior of compact stellar objects. Virtual photons, that decay into dileptons, are penetrating probes which directly access the entire space-time-evolution of the fireball and escape from the collision zone without further interactions. Thus they provide unique information about the various stages of the collision. In non-central collisions the initial spatial eccentricity of the nuclear overlap region transforms into momentum anisotropies through the action of azimuthally anisotropic pressure gradients. The most dominant contribution to this anisotropic flow is the second fourier harmonic v_2, the elliptic flow. The combined dependence of elliptic flow of dileptons on their transverse momentum and their invariant mass provides a rich landscape of structures, which allows to set the observational window on specific stages of the fireball evolution. First measurements of elliptic flow of dileptons at RHIC were just recently published by the STAR collaboration. To complement their results in the low mass region, the HADES experiment steps in. In this contribution the preliminary results on azimuthal

anisotropy of e^+e^- excess radiation measured in Au+Au collisions at $\sqrt{s_{NN}} = 2.4GeV$ will be presented. The extracted v_1 and v_2 components of dileptons with $M_{ee} < 150MeV/c^2$ will be compared to the results obtained for the charged pions.

HK 3.7 Mo 18:30 F 3

Measurement of low-mass dielectrons in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE — •Ivan Vorobyev for the ALICE-Collaboration — Technische Universität München, Excellence Cluster Universe

Low-mass dielectrons are a unique experimental tool to investigate the hot and dense medium created in ultra-relativistic heavy-ion collisions. Since they are created during all stages of the collision and do not interact strongly, they carry information about the medium properties unperturbed by strong final-state effects allowing us to probe the whole space-time evolution of the system.

Measurements of dielectron production in pp collisions serves as important vacuum reference to quantify modifications observed in heavy-ion collisions. It also provides complementary information on heavy-flavour production via correlated semi-leptonic decays. Recent studies of pp collisions with high charged-particle multiplicities showed surprising results similar to the observations previously seen in heavy-ion collisions. Measurements of low-mass dielectrons could provide additional information regarding the underlying physics processes.

In this talk we present the current status of the dielectron analysis with ALICE central barrel in pp collisions at a centre-of-mass energy of 13 TeV. A particular focus of the discussion will be put on the dielectron production in pp collisions collected with a trigger on high charged-particle multiplicities.

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HK 3.8 Mo 18:45 F 3

Results from a low-field pilot run dedicated for dielectron measurements in pp collisions at 13 TeV with ALICE — •Jerome Jung for the ALICE-Collaboration — Institut für Kernphysik Frankfurt

Low-mass dielectrons are an important probe for the hot and dense medium which is created in ultrarelativistic heavy-ion collisions. Since leptons do not interact strongly, they carry information from all collision stages with negligible final-state interaction.
The ALICE detector is well-suited to perform this measurement due to its excellent tracking and particle identification capabilities at very low momenta. However, Dalitz decays and photon conversions lead to a high combinatorial background. A detector configuration with reduced magnetic field increases their reconstruction probability allowing to exclude them from the analysis. Additionally, it also provides the opportunity to increase the accessible phase space of the dielectron measurement.
Such a configuration is planned for the Pb-Pb data taking in LHC Run 3. A successful pilot run using pp collisions was done and is used to adapt and develop analysis techniques. We will present first results of the dielectron measurement in pp collisions at $\sqrt{s}$ = 13 TeV with the low-field configuration and compare it to reference data with the nominal field to show its benefits.