HK 40: Heavy Ion Collisions and QCD Phases IX

Zeit: Donnerstag 14:00–16:15 Raum: F 3

HK 40.1 Do 14:00 F 3

Dielectron Production in Pb–Pb Collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV with ALICE — •Carsten Klein for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Electron-positron pairs (dielectron) are an excellent experimental probe to investigate the properties of the quark-gluon plasma which is formed during ultrarelativistic heavy-ion collions. Because they do not interact strongly their spectra reflect the entire space-time-evolution of the collision. The created medium can lead to a modification of the dielectron production with respect to the vacuum rate.
In the ALICE apparatus at the LHC electrons and positrons are identified by their specific energy loss in the Inner Tracking System (ITS) and in the Time Projection Chamber (TPC) combined with the time-of-flight information from TOF.
In this contribution, we give a status report on the recent dielectron measurements in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV in the central barrel of ALICE. For the first time, we show invariant mass and pair transverse momentum spectra for this collision system at this energy.
Supported by BMBF and the Helmholtz Association.

HK 40.2 Do 14:15 F 3

Separating prompt and non-prompt contributions in the di-electron mass spectrum in pp collisions at $\sqrt{s} = 7$ TeV with ALICE — •Sebastian Scheid for the ALICE-Collaboration — Institut für Kernphysik Frankfurt

Dileptons are a prime probe of the deconfined state of strongly interacting matter, the Quark Gluon Plasma (QGP), produced in high energy heavy ion collisions, as they are not affected by secondary hard interactions. A measurement of the thermal radiation from the QGP in the dielectron intermediate mass region allows to estimate the medium temperature. In this region the main component of the dielectron continuum is due to correlated semi-leptonic decays of B- and D-mesons. The proper decay length for B-mesons is $c\tau \approx 500\ \mu m$ and for D-mesons it is 100-300 μm, hence the reconstructed decay electrons do not point to the primary vertex of the collision.

Combining the measured distance of closest approach (DCA) of each single electron into a pair variable DCA_{ee} gives the possibility to separate prompt and non-prompt dielectron pairs.

The analysis in pp collisions allows to study the feasability of extracting the heavy-quark production with the current Inner Tracking System detector of ALICE and provides a reference for Pb–Pb collisions. In this talk, preliminary results on the DCA_{ee} spectra in pp collisions at $\sqrt{s} = 7$ TeV will be shown and compared to reference distributions from MC simulations.

HK 40.3 Do 14:30 F 3

Low mass dielectrons from Au+Au Collisions at $1.23A$ GeV with HADES — •Patrick Sellheim — Goethe-Universität Frankfurt

Dielectrons are well suited to access the hot and dense stage of heavy-ion collisions and to identify hadron modifications induced by the medium. In the past years, various experiments measured dileptons and observed in the low mass region an excess over the so-called hadronic cocktail. In continuation of these studies, HADES measured e^+e^- production in Au+Au collisions at $1.23A$ GeV.

In this contribution, the reconstructed e^+e^- pair spectra will be presented. The multi-differential analysis allows to extract properties of strongly interacting matter at low collision energies. Moreover, the reconstructed pair spectra will be compared to microscopic transport model calculations, but also to the coarse-graining approaches.

This work has been supported by BMBF (05P15RFFCA), GSI, HIC for FAIR, HGS-HIRe and H-QM.

HK 40.4 Do 14:45 F 3

In-Medium Spectral Functions of Vector- and Axial-Vector Mesons from the Functional Renormalization Group — •Christopher Jung[1,2], Fabian Rennecke[1,3], Ralf-Arno Tripolt[4], Lorenz von Smekal[1], and Jochen Wambach[2,4] — [1]Justus-Liebig-Universitaet Giessen, Germany — [2]TU Darmstadt, Germany — [3]Ruprecht-Karls-Universitaet Heidelberg, Germany — [4]ECT*, Italy

We present first results on vector and axial-vector meson spectral functions as obtained by applying the non-perturbative functional renormalization group approach to an effective low- energy theory motivated by the gauged linear sigma model. By using a recently proposed analytic continuation method, we study the in-medium behavior of the spectral functions of the ρ and a_1 mesons in different regimes of the phase diagram. In particular, we demonstrate explicitly how these spectral functions degenerate at high temperatures as well as at large chemical potentials, as a consequence of the restoration of chiral symmetry. (arXiv:1610.08754)

HK 40.5 Do 15:00 F 3

Thermal dilepton emission as a fireball probe — •Florian Seck[1], Tetyana Galatyuk[1,2], Ralf Rapp[3], and Joachim Stroth[4,2] — [1]TU Darmstadt — [2]GSI, Darmstadt — [3]Texas A&M Univ., College Station, USA — [4]Goethe-Universiät Frankfurt

Collisions of heavy ions at (ultra-)relativistic energies offer the opportunity to explore strongly interacting matter across the QCD phase diagram. Electromagnetic probes are an excellent tool for these investigations as they are emitted during the whole evolution of the collision and decouple from the interaction zone once they are produced. They carry information about the properties of matter created inside the hot and dense fireball to the detector which is irretrievable from the spectra of final-state hadrons due to rescattering. In particular, the yield of thermal low-mass dileptons is sensitive to the fireball lifetime, while the slope in the intermediate-mass region of the dilepton invariant-mass spectrum can serve as a true thermometer of the medium.

Realistic thermal dilepton emission rates and a coarse-graining method for the fireball's space-time evolution are utilized to properly describe the contribution of in-medium signals to the dilepton invariant-mass spectrum. The obtained results will be compared to the excitation function of the lifetime and temperatures of the fireball established at higher energies. The results can serve as a baseline for future explorations by the HADES and CBM experiments at FAIR as well as the RHIC beam energy scan phase II.

This work has been supported by: VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI.

HK 40.6 Do 15:15 F 3

Machine learning for the analysis of low-mass dielectrons on Run II data with ALICE — •Alex Chauvin for the ALICE-Collaboration — Excellence Cluster, Garching, Germany

Dielectron pairs are an experimental tool to investigate the Quark Gluon Plasma (QGP), which is expected to be created during ultra-relativistic heavy-ion collision. The measured electron-positron pairs are created at different stages of the evolution of the hot and dense medium and do not interact strongly with the latter. Hence, dielectron pairs can carry information to describe the space-time evolution of the system, thereby allowing us to investigate the predicted restoration of chiral symmetry.

However, photon conversions contribute largely to the background of the dielectron signal we are after. Whereas dielectron pairs at very low mass ($<$ 100MeV) are created, photon conversion rejection leads to systematic uncertainty in the crucial mass range used for normalisation and extraction of virtual photons. The Toolkit for Multi-Variable Analysis allows us to consider several variables with different classification methods, such as Boosted Decision Trees, while obtaining a higher signal efficiency.

In this talk we will present the advantages of using machine learning for background rejection and how this method preserves signal efficiency. To illustrate it, we will further apply the method on the Run II data recorded by the ALICE experiment.

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

HK 40.7 Do 15:30 F 3

Neutral meson and direct photon measurements using conversions in proton-proton collisions at $\sqrt{s} = 7$ TeV in ALICE — Nicolas Schmidt and •Lucas Altenkämper for the ALICE-Collaboration — Physikalisches Institut, Heidelberg University

The ALICE detector is dedicated to study the properties of the Quark-Gluon-Plasma, which is created in Pb-Pb collisions at high energies. The spectra in pp collisions are used to obtain a baseline of hadron

production for heavy-ion collisions and can provide additional information to understand pQCD predictions at LHC energies. This work focuses on the measurement of neutral mesons via their two photon decay channel as well as the direct photon measurement using conversions in the detector material. For this, the ALICE Inner Tracking System (ITS) and the Time Projection Chamber (TPC) are mainly used. The status of the analysis in pp collisions at $\sqrt{s} = 7$ TeV will be presented. Step by step, the signal extraction and applied efficiency correction will be explained. Final results are discussed and put into context with measurements at other LHC energies.

HK 40.8 Do 15:45 F 3

Photon Production in a Hadronic Transport Approach — •Anna Schäfer[1,2], Niklas Ehlert[2], Juan M. Torres-Rincon[1], and Hannah Petersen[1,2,3] — [1]Frankfurt Institute for Advanced Studies, D-60438 Frankfurt am Main, Germany — [2]Institut für Theoretische Physik, Goethe-Universität, D-60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany

Photons play an important role in the investigation and understanding of the QGP. Unlike hadrons, which are likely to interact with the medium before detection, photons only interact electromagnetically, their mean free path is much larger than the size of the system. They are direct probes of the observed medium and offer unique insights into the fireball and the hadronic phase. Additionally, measurements at RHIC and LHC show unexpectedly large momentum anisotropies for photons presumably produced in the hadronic phase of heavy ion collisions. Further investigation of photons in a strongly-interacting medium is hence necessary to solve the *direct photon flow puzzle*.

To improve the theoretical understanding of photons at low energies in heavy ion reactions, scattering processes involving photons have been implemented into a hadronic transport approach (SMASH), which simulates hot and dense strongly-interacting nuclear matter. Comparisons of the obtained thermal rates in infinite matter calculations to the ones used in hydrodynamic calculations will be shown. The plan for the future is to apply this hadronic transport approach within a hybrid approach to RHIC/LHC energies.

HK 40.9 Do 16:00 F 3

Direct Photon Simulations with POWHEG BOX — •Hendrik Poppenborg — Institut für Kernphysik, Münster

Direct photons provide particular insight into nuclear collisions. Since they give immediate access to the energy scale of a hard scattering, direct photons allow further constraints of (nuclear) parton distribution functions, especially on the poorly known distribution of initial state gluons.

We present the POWHEG BOX implementation of the dominant direct photon production processes $qg \to q\gamma$ and $q\bar{q} \to g\gamma$ at Next-to-Leading Order, interfaced with the PYTHIA8 parton shower. We aim for a robust description of direct photons and investigate therefore various simulation parameters of both the hard scattering kernel and the shower Monte Carlo. We present comparisons to direct/isolated photon measurements from ATLAS, CMS and ALICE and evaluate the improvement with respect to the PYTHIA8 standalone description. In preparation of the differential direct photons measurements to come, we will in addition provide a study about gamma-hadron and gamma-jet correlations including isolation criteria.

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