HK 22: Heavy-Ion Collisions and QCD Phases IV

Time: Thursday 16:30–18:30 Location: H1

Group Report HK 22.1 Thu 16:30 H1

Soft dielectron production in pp and Pb–Pb collisions with ALICE — •Jerome Jung for the ALICE-Collaboration — IKF, Goethe University Frankfurt, Germany

The production of soft dielectrons is an exceptional and versatile tool to study the underlying mechanisms and properties of hadron-hadron and heavy-ion collisions (HIC). In HIC, the STAR collaboration observed first a clear excess of dielectrons produced at low pair momenta which exceeded the hadronic decay background. These soft dielectrons can be attributed to coherent photoproduction originating in the interaction of the highly contracted electromagnetic fields of the colliding ions, a sole QED process. In hadronic collisions, several experiments observed an excess at low momenta for real as well as virtual photons beyond hadronic decays which could not be explained by initial- and final-state bremsstrahlung either. As this soft-photon puzzle is absent in purely leptonic collisions, the origin of the effect seems to be connected to QCD.
In this talk, ALICE measurements of dielectron production in pp and (semi-) peripheral Pb–Pb collisions, will be presented. The pp collisions are recorded with a reduced magnetic field of the central barrel solenoid of 0.2 T. This enables the investigation of a kinematic domain at low invariant mass m_{ee} and pair transverse momentum $p_{\mathrm{T,ee}}$, which was previously inaccessible at the LHC. Comparison of the measured dielectron yield to the hadronic decay cocktail indicates a clear enhancement of soft dielectrons in both systems. Finally, the excess spectra are extracted and compared to theoretical model calculations.

HK 22.2 Thu 17:00 H1

Centrality and system size dependence of the thermal dilepton excess yield in HADES — •Niklas Schild for the HADES-Collaboration — TU Darmstadt, Darmstadt, Germany

Electromagnetic probes offer a unique opportunity to study the conditions in heavy-ion collisions throughout their whole evolution. In particular, the spectral shapes of dilepton distributions entail information about the temperature of the hot and dense fireball, while the integrated dilepton yield can be connected to the lifetime of the colliding system.

The collision centrality as well as the beam energy are arguably the two major determinants for the conditions reached in heavy-ion collisions. Less clear is the impact of the ion species or the spectator matter. For this reason, the HADES collaboration has recorded events for two collision systems at the same energy: Au+Au in April 2012 and Ag+Ag in March 2019, both at 1.23A GeV.

We present first results of the measured Ag+Ag thermal dilepton radiation and compare the extracted temperature of the fireball as well as the normalised excess yield to the measurements from Au+Au collisions.

HK 22.3 Thu 17:15 H1

Thermal dileptons in a coarse-grained transport and hydrodynamics — •Maximilian Wiest[1], Tetyana Galatyuk[1,2], Ralf Rapp[3], Florian Seck[1], Joachim Stroth[2,4], and Jan Steinheimer[4,5] — [1]TU Darmstadt — [2]GSI, Darmstadt — [3]Texas A&M Univ, College Station, USA — [4]Goethe-Universität, Frankfurt — [5]FIAS, Frankfurt

Dileptons provide a unique way to access the properties of the fireball created in heavy-ion collisions. Hadrons are not suited for doing this in the same way, since their properties are subject to the strong interactions in the fireball. We study dilepton production in the SIS18 energy range by utilizing an approach that uses coarse-grained transport simulations to calculate thermal dilepton emission applying state-of-the-art in-medium spectral functions from hadronic many-body theory. To ensure an accurate description of the fireball, we have used several microscopic transport models and compared the effect of the space-time evolution on resulting dilepton spectra. We will also present a systematic comparison of the results for different colliding nuclei as well as for the number of individual participants in the collision (system size) and different collision energies as measured recently by the HADES Collaboration.

Supported by VH-NG-823, DFG CRC-TR 211 and GSI

HK 22.4 Thu 17:30 H1

Direct Photon Production in pp collisions at $\sqrt{s}$ = 13 TeV as a Function of Multiplicity with ALICE — •Ilya Fokin für die ALICE-Kollaboration — Physikalisches Institut, Universität Heidelberg, Heidelberg, Germany

Thermal direct photons are a sign of the production of a quark-gluon-plasma (QGP). They have been measured in PbPb collisions by ALICE while measurements in pp collisions showed no enhancement over the decay photon cocktail. Some collective effects, which could be explained by a QGP, such as long-range two-particle correlations have been observed not only in heavy-ion collisions, but also in high-multiplicity pp collisions. An enhancement of the direct photon production at low transverse momentum in high-multiplicity collisions compared to low-multiplicity collisions would suggest the creation of a QGP also in pp collisions.

In this talk, a measurement of the direct photon production in pp collisions at 13 TeV as a function of the charged particle multiplicity with ALICE is presented. Photons are reconstructed using the photon conversion method, relying on pair conversions in the detector material. π^0 and η mesons are reconstructed via their two-photon decay channels for the calculation of the decay photon cocktail.

HK 22.5 Thu 17:45 H1

Dielectron physics opportunities with ALICE 3 — •Florian Eisenhut for the ALICE-Collaboration — IKF, Universität Frankfurt am Main, Deutschland

The ALICE 3 experiment is planed as a compact, next-generation multipurpose detector at the LHC as a follow-up to the present ALICE experiment. It will provide unprecedented tracking and vertexing capabilities down to a few tens of MeV/c in pp, pA and AA collisions at luminosities up to a factor 50 times higher than what will be possible with the upgraded ALICE detector. Such detector performances allow to study the very soft dielectron productions connected to the electric conductivity of the medium via thermal dielectrons in heavy-ion (AA) collisions. At higher dielectron invariant masses (m_{ee}), the measurement of thermal radiation from the hadron gas is possible, which becomes sensitive to the chiral symmetry mixing between ρ and a_1 mesons. Overall, these conditions will provide unique opportunities for dielectron measurements.

This talk will give an overview of the performance studies for dielectron analyses with the ALICE 3 experiment aiming at specific criteria to optimise the layout of the detector. A possible way to identify electrons using different PID scenarios will be presented together with the resulting track and pair efficiencies and the expected m_{ee} resolution. Finally the capability to reject the heavy-flavour background will be discussed based on the expected raw dielectron yield in central AA collisions as a function of the pair distance-of-closest approach to the primary vertex.

HK 22.6 Thu 18:00 H1

Photon and dilepton rates in the low energy regime and electrical conductivity — •Charlotte Gebhardt and Stefan Flörchinger — Institut für Theoretische Physik, Universität Heidelberg

We combine next to leading (NLO) computations on the thermal spectral function with results from hydrodynamic simulations with mode expansion (FluiduM) to study the eletrical conductivity of the Quark Gluon Plasma (QGP). Therefore we fit and modify the thermal spectral function, such that electrical conductivity can be varied. Further we present how this has an impact on the thermal particle spectra in the low energy regime. Results are shown for a simulated QGP of a Pb-Pb-collision at $\sqrt{s_{NN}} = 2.76\,TeV$ and $\sqrt{s_{NN}} = 5.02\,TeV$. The aim is to find a way to gain insights on the electrical conductivity of the QGP from measurements of thermal photons and dileptons.

HK 22.7 Thu 18:15 H1

Measurement of Neutral Mesons in pp Collisions at $\sqrt{s}$ = 13 TeV with ALICE — •Joshua König for the ALICE-Collaboration — IKF, Goethe-Universität Frankfurt

ALICE, the dedicated heavy-ion experiment at the LHC, investigates the properties of the quark-gluon plasma (QGP) that is believed to be produced in central AA collisions at high center-of-mass energies. Measurements in pp collisions provide a baseline for the AA collision

system and can furthermore constrain the description of hadronization and fragmentation. Multidifferential measurements of neutral meson (π^0, η, ω) production as function of p_{T} and the multiplicity can give further constraints on the particle production mechanisms. Moreover, these measurements provide the baseline for direct-photon analyses.

The reconstruction of neutral mesons via their two photon-decay channel can be realized in ALICE with several complementary methods, utilizing the calorimeters and the TPC. In this talk, the status of the light neutral meson analyses in pp collisions at $\sqrt{s} = 13$ TeV with ALICE will be presented.

Supported by BMBF and the Helmholtz Association