HK 33: Schwerionenkollisionen und QCD Phasen

Zeit: Mittwoch 16:30–19:00 Raum: HZ 6

Gruppenbericht HK 33.1 Mi 16:30 HZ 6

Photon and dilepton production across collision energies and centralities — •Olena Linnyk[1], Elena Bratkovskaya[2,3], and Wolfgang Cassing[1] — [1]Justus Liebig Universität Gießen, Gießen, Deutchland — [2]Johann Wolfgang Goethe Universität, Frankfurt am Main, Deutchland — [3]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Deutchland

Real and virtual photons are established messengers of chiral symmetry restoration and deconfinement phase transition in heavy-ion collisions. We calculate the emission of photons and dileptons throughout the evolution of the heavy-ion collisions using the parton-hadron-string dynamics (PHSD) transport approach and interpret the recent observations of the strong photon elliptic flow at RHIC and LHC simultaneously with the precisely measured photon and dilepton spectra. This allows us to disentangle the individual hadronic and partonic emission sources and to conclude on the characteristics of the produced QCD matter – the temperatures, densities and the degree of thermalisation reached, the lifetime of the QGP and the modification of vector mesons. Comparing the known sources to the data, we examine the possibility to accommodate new effects, such as the photon production in the initial pre-equilibrium phase and the dilepton production in the mixed phase. Additionally, we provide predictions for the dilepton spectra at LHC, the collision centrality dependence of the photon yield at RHIC, and the excitation function of the low-mass dilepton yield, thus investigating the potential of the dilepton measurements within the RHIC beam energy scan program, FAIR and NICA facilities.

HK 33.2 Mi 17:00 HZ 6

Dielectron production in pp collisions at $\sqrt{s} = 7$ TeV with ALICE at the LHC — •Markus K. Köhler for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

Dileptons provide an important probe for the medium, which can be created in heavy-ion collisons. Thereby, proton-proton collisions are crucial as a reference measurement.
We will present the latest results on the dielectron analysis in minimum-bias proton-proton collisons at $\sqrt{s} = 7$ TeV with the ALICE detector system at the LHC, CERN. The results will be compared to the expected hadronic sources. This measurement provides also the possibility to extract the total charm cross section and the yield of direct photons.
Moreover, first results for a high-p_t dielectron analysis with events triggered using the electromagnetic calorimeter will be shown.

HK 33.3 Mi 17:15 HZ 6

Measurement of Low-Mass Dielectron Production in Pb–Pb Collisions with ALICE — •Patrick Reichelt 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 thermal photons are an important probe for the study of the evolution of the hot and dense medium created in heavy-ion collisions. In particular, the extraction of virtual photons in the low-mass region provides a complimentary measurement of the real photon yield. In the ALICE apparatus at the LHC, electrons at mid-rapidity are identified by their specific energy loss in the Inner Tracking System (ITS) and the Time Projection Chamber (TPC), combined with time-of-flight information from TOF. We will present the status of the low-mass dielectron analysis in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, involving these detector systems. Special emphasis will be laid on the extraction of the virtual photon yield. The invariant mass distribution will be compared to the expected hadronic sources.

Supported by BMBF and the Helmholtz Association.

HK 33.4 Mi 17:30 HZ 6

Prospects of Low-Mass Dielectron Measurements in ALICE with an upgraded Central Barrel Detector — •Carsten Klein for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The measurement of electron-positron pairs in the low invariant mass region allows to study vacuum and in-medium properties of light vector mesons. Dielectrons also probe the production of thermal photons in heavy-ion collisions. ALICE is well-suited to perform this measurement due to its tracking and particle identification capabilities at very low momenta. However, Dalitz decays and photon conversions lead to a high combinatorial background. Additionally, coincident semi-leptonic decays of charm and anti-charm hadrons produce a continuum signal, which dominates over the thermal dielectron signal. Both contributions can be reduced by an upgraded Inner Tracking System (ITS), to be installed during LHC's long shutdown 2 (2018). It will further improve the tracking efficiency at low p_{T} and provide detection capabilities for electrons from secondary vertices like conversions and heavy-quark decays. A simulation with the final design for an upgraded ITS was carried out. Our prediction of the impact on the low-mass dielectron measurement in Pb-Pb collisions at full LHC energy will be presented.
Supported by BMBF and the Helmholtz Association.

HK 33.5 Mi 17:45 HZ 6

How robust is a thermal photon interpretation of the ALICE low-p_T data? — Michael Klasen[1], Christian Klein-Bösing[2,3], •Florian König[1], and Johannes Wessels[2] — [1]Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster — [2]Institut für Kernphysik, Westfälische Wilhelms-Universität Münster — [3]ExtreMe Matter Institute, GSI, Darmstadt

We present a rigorous theoretical analysis of the ALICE measurement of low-p_T direct-photon production in central lead-lead collisions at the LHC with a centre-of-mass energy of $\sqrt{s_{NN}} = 2.76$ TeV. Using NLO QCD, we compute the relative contributions to prompt-photon production from different initial and final states and the theoretical uncertainties coming from independent variations of the renormalisation and factorisation scales, the nuclear parton densities and the fragmentation functions. Based on different fits to the unsubtracted and prompt-photon subtracted ALICE data, we consistently find $T = 304 \pm 58$ MeV and 309 ± 64 MeV for the effective temperature of the quark-gluon plasma (or hot medium) at $p_T \in [0.8; 2.2]$ GeV and $p_T \in [1.5; 3.5]$ GeV as well as a power-law (p_T^{-4}) behavior for $p_T > 4$ GeV as predicted by QCD hard scattering.

HK 33.6 Mi 18:00 HZ 6

Real and virtuell photon emission within effective quark-meson models — •Falk Wunderlich[1,2] and Burkhard Kämpfer[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstr. 400, 01328 Dresden, Germany — [2]Institut für Theoretische Physik, TU Dresden, Zellescher Weg 17, 01062 Dresden

Certain aspects of the behaviour of strongly interacting matter can be understood in terms of effective models. Among such models are the quark-meson models. With a suitable choice of parameters and field content their phase diagram exhibits a 1st order phase transition that terminates in a critical point at nonzero chemical potential. Including the electromagnetic sector we investigate the dependence of the real and virtual photon rates on temperature and chemical potential with emphasis on peculiarities near the critical point.

HK 33.7 Mi 18:15 HZ 6

Low-mass di-electron reconstruction at the CBM experiment at FAIR — •Elena Lebedeva[1], Claudia Höhne[1], and Tetyana Galatyuk[2] for the CBM-Collaboration — [1]Justus-Liebig-Universität Gießen, Gießen, Germany — [2]Technische Universität Darmstadt, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment at the future FAIR facility will investigate high baryon density matter at moderate temperatures in A+A collisions from 4-35 AGeV. One of the key observables of the CBM physics program is electromagnetic radiation from the early fireball carrying undistorted information on its conditions to the detector. This includes detailed investigations of low-mass vector mesons in their di-electron channel. In the presented simulation studies we investigate the feasibility to effectively reduce the combinatorial background with the currently foreseen experimental setup, which does not provide electron identification in front of the magnetic field. The strategy of electron identification and background suppres-

sion will be discussed. Simulation results with most-up-to date realistic detector description as well as detailed background studies will be presented.

HK 33.8 Mi 18:30 HZ 6

Electric and magnetic response of hot QCD matter — •Thorsten Steinert and Wolfgang Cassing — Institut für Theoretische Physik, Universität Giessen, 35392 Giessen, Germany

We study the electric conductivity as well as the magnetic response of hot QCD matter at various temperatures T and chemical potentials μ_q within the off-shell Parton-Hadron-String Dynamics (PHSD) transport approach for interacting partonic systems in a finite box with periodic boundary conditions. The response of the strongly-interacting system in equilibrium to an external electric field defines the electric conductivity σ_0 whereas the response to a moderate external magnetic field defines the induced diamagnetic moment $\mu_L\ (T, \mu_q)$ as well as the spin susceptibility $\chi_S(T, \mu_q)$. We find a sizeable temperature dependence of the dimensionless ratio σ_0/T well in line with calculations in a relaxation time approach for $T_c < T < 2.5T_c$ as well as an increase of σ_0 with μ_q^2/T^2. Furthermore, the frequency dependence of the electric conductivity $\sigma(\Omega)$ shows a simple functional form well in line with results from the Dynamical QuasiParticle Model (DQPM). The spin susceptibility $\chi_S(T, \mu_q)$ is found to increase with temperature T and to rise $\sim \mu_q^2/T^2$, too. The actual values for the magnetic response of the QGP in the temperature range below 250 MeV show that the QGP should respond diamagnetically in actual ultra-relativistic heavy-ion collisions since the maximal magnetic fields created in these collisions are smaller than $B_c(T)$ which defines a boundary between diamagnetism and paramagnetism.

HK 33.9 Mi 18:45 HZ 6

Inhomogeneous phases in effective quark models — •Achim Heinz, Francesco Giacosa, Marc Wagner, and Dirk H. Rischke — Institut of Theoretical Physics, Frankfurt am Main, Germany

Chiral symmetry is a symmetry of the QCD Lagrangian, which is spontaneously broken due to nonperturbative phenomena. As a consequence, a chiral condensate, which corresponds to a vacuum's condensate of quark-antiquark pairs, emerges. Usually, this condensate is treated as constant over space, but analytic as well as numerical studies show that an inhomogenous condensation is favored at high density. However, in most cases it is not possible to calculate analytically the emergence of inhomogeneous condensation. Therefore it is important to improve numerical methods: in the talk, we present a new numerical approach which is capable to reproduce well-known analytic results in 1+1 as well as in 1+3 dimensions. We also outline which studies can be performed with this method in the near future.