HK 34: Heavy-Ion Collisions and QCD Phases VII

Time: Wednesday 16:30–18:30 Location: J-HS F

Group Report HK 34.1 Wed 16:30 J-HS F

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

Low-mass dielectrons present an exceptional tool to deepen our understanding of the Quark-Gluon Plasma (QGP) created in the collision of ultra-relativistic heavy-ions, since they are produced at all stages of the collision while being unaffected by the strong interaction. To single out the interesting signal characteristics of the QGP, the primordial e^+e^--pair production in vacuum has to be understood first. Therefore, measurements in pp collisions serve as a medium-free baseline while the measurements in p-Pb collisions help to separate cold nuclear matter effects from those of the hot and dense medium.

In this talk, recent results of the dielectron measurements from the ALICE experiment will be presented. For the first time, dielectron production is studied via a consistent system scan of pp, p-Pb and Pb-Pb collisions at $\sqrt{s_{\rm NN}}$=5 TeV displaying medium modifications as a function of invariant mass and pair transverse momentum. Finally, super-soft dielectron production is discussed comparing the measurement of pp collisions at $\sqrt{s}$=13 TeV using a low-magnetic field setup with expectations from known hadronic sources to address the long-standing question of a possible soft-dilepton excess in pp collision at LHC energies.

Supported by BMBF and the Helmholtz Association.

HK 34.2 Wed 17:00 J-HS F

Low-mass dielectron measurements in minimum-bias pp collisions at 5.02 TeV with ALICE — •Leonhardt Viebach for the ALICE-Collaboration — Goethe Universität Institut fur Kernphysik, Johann Wolfgang Goethe-Universitat Frankfurt (IKF), Frankfurt, Germany

Low-mass dielectrons play a key role in the understanding of the chiral-symmetry restoration and in the study of the Quark-Gluon Plasma (QGP). To single out the interesting signal characteristics of the QGP, the primordial e^+e^- pair production in vacuum needs to be first understood. It can be studied in minimum-bias pp collisions. Dielectron measurements in elementary collision systems serve not only as a reference for the heavy-ion analysis but provide also a test for Monte-Carlo event generators, aiming to reproduce the heavy-flavour production mechanisms. In this talk, I will present the results of the dielectron analysis in pp collisions at $\sqrt{s} = 5.02$ TeV with ALICE. The dielectron yield is studied as a function of invariant mass and pair transverse momentum and compared to the expected dielectron yield from known hadronic sources. The charm and beauty production cross sections are extracted from the data by fitting the spectra in the intermediate-mass region and are then compared to measurements at $\sqrt{s} = 7$ TeV and $\sqrt{s} = 13$ TeV as well as to single heavy-flavour hadron measurements and to FONLL calculations. Finally, the results in pp collisions can be compared to Pb–Pb and p–Pb results measured at the same center of mass energy per nucleon, $\sqrt{s_{\rm NN}} = 5.02$ TeV, which allows a direct comparison to estimate cold- and hot-nuclear matter effects.

HK 34.3 Wed 17:15 J-HS F

Azimuthal anisotropy of virtual photons measured with HADES — •Dominique Dittert for the HADES-Collaboration — Technische Universität Darmstadt

In Au+Au collisions at $\sqrt{s_{NN}} = 2.42$ GeV HADES observed a strong excess radiation which is remarkably well described assuming emission out of a thermalized system. The observation of a dilepton azimuthal anisotropy or the elliptic flow (v_2) would add an important evidence for a collective expansion dynamics, and would thus shine extra light to the possible origin of the excess radiation. We present results for azimuthal anisotropy of e^+ e^- excess. To characterize the emitting source further, we study the orientation of the electron decay axis in the virtual photon rest (helicity) frame. Prospects for dilepton v_2 from the Ag+Ag at $\sqrt{s_{NN}} = 2.55$ GeV run will be shown.

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HK 34.4 Wed 17:30 J-HS F

Thermal dileptons in a coarse-grained transport dynamics — •Maximilian Wiest[1], Tetyana Galatyuk[1,2], Ralf Rapp[3], Florian Seck[1], and Joachim Stroth[2,4] — [1]TU Darmstadt — [2]GSI, Darmstadt — [3]Texas A&M Univ, College Station, USA — [4]Goethe-Universität, 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 34.5 Wed 17:45 J-HS F

Signal for a 1$^{\rm st}$ order phase transition in dilepton spectra — •Florian Seck[1], Tetyana Galatyuk[1,2], Ayon Mukherjee[3,4], Ralf Rapp[5], Jan Steinheimer[4], and Joachim Stroth[2,3] — [1]TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]Goethe-Universität Frankfurt, Germany — [4]FIAS, Frankfurt, Germany — [5]Texas A&M University, College Station (TX), USA

Due to their penetrating nature dileptons are an excellent tool to study the properties of hot and dense QCD matter created in relativistic heavy-ion collisions. Thermal dilepton emission rates need to be folded with the space-time dynamics of the fireball to calculate the invariant mass spectrum of the excess radiation recorded in heavy-ion experiments. One approach, that has been established to reproduce the measured data in the energy regime of a few GeV, is the coarse-graining of microscopic transport simulations.

In this contribution we present our study on the applicability of ideal relativistic hydrodynamics for the fireball evolution with two different equations of state provided by the Quark-Hadron Chiral Parity Doublet (QχP) model – one with a cross-over and one with a 1$^{\rm st}$ order phase transition. We compare the properties of the resulting invariant mass and transverse momentum spectra for the two cases. We show how and why the dilepton spectra are modified in the presence of a phase transition and discuss the implications for the search of landmarks in the QCD phase diagram via dileptons.

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HK 34.6 Wed 18:00 J-HS F

Feasibility studies of low mass di-electrons with the HADES and CBM experiments at FAIR SIS100 — •Marten Becker for the HADES-Collaboration — Justus-Liebig-Universität Giessen

The High Acceptance DiElectron Spectrometer (HADES) and the Compressed Baryonic Matter experiment (CBM) are dedicated to study strongly interacting matter at high net-baryon densities and moderate temperatures. di-electrons as penetrating probes are a key observable to get direct access to the properties of the fireball generated in A+A collisions.

Currently the HADES experiment is located at SIS 18 at GSI, Darmstadt and will be moved in future to continue its physics program at SIS100 where higher beam energies are available. Both experiments, HADES and CBM are complementary to each other in terms of detector setup and measureable energy range making it interesting to study one system at both experiments for comparison and verification of the CBM results. Currently Ag+Ag collisions at 4.5A GeV is favored.

We present di-electron feasibility studies based on simulated Ag+Ag collisions at 4.5A GeV for the HADES and CBM detector setup and compare the results.

HK 34.7 Wed 18:15 J-HS F

Simulations of thermal dielectrons for the CBM experiment — •Etienne Bechtel for the CBM-Collaboration — Goethe Univer-

sity Frankfurt , IKF

The Compressed Baryonic Matter (CBM) experiment will access a wide range of physics observables for heavy-ion collisions in the region of highest net- baryon densities. One of the important topics of its physics program is the study of rare dilepton channels, which were not precisely measured before with other experiments in this energy range. The spontaneously broken chiral symmetry of the vacuum is assumed to be restored at finite temperatures and net-baryon densities and should be accessible in heavy-ion collisions. A precision measurement of the ρ-meson and its chiral partner, the a_1-meson, would be sensible to this restoration. On the other hand, the measurement of direct thermal photons from the early stages of the fireball evolution provides information about the temperature of the emitting source and its excitation function and could provide hints for a potential first order phase transition. This talk will cover the newest results on the simulation of different dielectron channels, including the measurement of the thermal radiation of the fireball itself, as well as newly added machine learning techniques in the analysis chain. This work is supported by BMBF.