HK 2: Heavy Ion Collision and QCD Phases I

Zeit: Montag 14:00–16:00 Raum: S1/01 A01

Gruppenbericht HK 2.1 Mo 14:00 S1/01 A01

Dilepton reconstruction in Au+Au collisions at 1.23A GeV with HADES — •Patrick Sellheim for the HADES-Collaboration — Goethe-Universität Frankfurt

In continuation of a systematic investigation of the emissivity of strongly interacting matter, HADES has recently measured the di-electron emission in $Au + Au$ collisions at 1.23A GeV beam energy. Due to the high track density reached for this collision system, different reconstruction strategies have been pursued to achieve optimal reconstruction efficiencies and purities. Electron (positron) candidates have been identified by means of an multi-variate analysis, where the neural network has been trained alternatively based on clean signal and background tracks from data and by simulated tracks. Moreover, the electron track candidates have been matched to rings using ring parameters of found rings or, alternatively, track candidates identified by time-of-flight only have been matched to ring signatures without running the ring finder before.

This contribution will present the results of these analysis procedures and will discuss systematic uncertainties obtained. The statistics is sufficient to investigate double-differential distributions, like centrality dependence covering 45% most central events or transverse momentum distributions for different regions in invariant mass. Special emphasis will be given to the extraction of the radiation from the dense phase of the collision.

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HK 2.2 Mo 14:30 S1/01 A01

Studying ρ-N couplings with HADES in pion-induced reactions — •Federico Scozzi for the HADES-Collaboration — TU Darmstadt — IPN Orsay, France

It has been established that baryon-driven medium effects are the key in describing the low mass excess measured in heavy-ion collisions. Yet to understand better medium effects one needs measurement of electromagnetic transition form factors in the time-like region. The coupling of virtual photons to baryonic resonances can be experimentally probed by means of $\pi^- N \to R \to e^+e^- N$ processes for which no experimental data exist.

In summer 2014 data were taken with the High Acceptance Di-Electron Spectrometer (HADES) at GSI in pion-induced reactions using carbon and polyethylene targets. A large part of the data was taken at a pion beam momentum of 0.69 GeV/c in order to explore the sub-threshold coupling of the ρ to baryonic resonances. Combining polyethylene data with carbon data it is possible to extract pion-proton interactions. In this contribution the preliminary results of inclusive dilepton invariant mass will be presented and compared with model calculations. Finally the exclusive channel $\pi^- p \to e^+e^- n$ will be discussed in detail.

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

HK 2.3 Mo 14:45 S1/01 A01

The electromagnetic N-Δ transition form factor and its impact on dilepton spectra — •Janus Weil[1], Gilberto Ramalho[2], Teresa Pena[3], Hendrik van Hees[1], and Ulrich Mosel[4] — [1]Frankfurt Institute for Advanced Studies — [2]Federal University of Rio Grande do Norte — [3]Universidade de Lisboa — [4]Universität Giessen

The Dalitz decay of $\Delta \to N e^+e^-$ represents an important contribution to inclusive dilepton spectra. However, unlike the mesonic Dalitz decays, the transition form factor in this decay is not very well-constrained so far. There is plenty of electron-scattering data to fix the tails of the form factor in the space-like regime, but the more interesting region is certainly the time-like regime, where one expects to find one or more vector-meson poles. However, the only experimental constraints in the time-like regime come from dilepton spectra, which are not straightforward to interpret, in particular since they contain contributions from several other processes (including N^* and Δ^* decays) that need to be disentangled from each other. We discuss different models for the N-Δ transition form factor, including a simple VMD-like approach and a covariant spectator quark model, where one distinguishes contributions from a bare quark core and a meson cloud. These form-factor models are then coupled with a hadronic transport model, in order to simulate the dynamics of pp and heavy-ion collisions and compute inclusive dilepton spectra. By comparing those to data measured with the HADES detector, we obtain constraints on the N-Δ transition form factor and discuss their implications.

HK 2.4 Mo 15:00 S1/01 A01

Dileptons never die: measurement of virtual photons radiated from Au+Au collisions at $E_{\mathrm{beam}} = 1.23$ AGeV into HADES. — •Szymon Harabasz for the HADES-Collaboration — TU Darmstadt

Dileptons are a unique probe to direct study properties of hot and dense medium formed in heavy-ion collisions, thanks to their mean-free path much larger than the size of the fireball. Excess of the low-mass lepton pairs has been measured in heavy-ion collisions from SIS up to top RHIC energies. Substantial medium effects on light vector-mesons originate from their coupling to baryons and anti-baryons. In baryon-rich fireballs the low-mass excess is expected to be maximum.

This is the paramount topic in the experimental program conducted at SIS18 accelerator in GSI with the help of the High Acceptance Di-Electron Spectrometer. The strong non-linear system size dependence of the yield component exceeding the NN reference has been extracted from former C+C and Ar+KCl runs.

This contribution will present results of virtual photon production from high statistics Au+Au at $E_{\mathrm{beam}} = 1.23$ AGeV data and confront them with the reference measured by HADES and with results of previous runs as well as with available model predictions. The integrated excess yield will be put in context of the dilepton excitation function measured by STAR.

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

HK 2.5 Mo 15:15 S1/01 A01

Modeling thermal dilepton radiation for SIS experiments — •Florian Seck for the HADES-Collaboration — TU Darmstadt

Dileptons are radiated during the whole time evolution of a heavy-ion collision and leave the interaction zone unaffected. Thus they carry valuable information about the hot and dense medium created in those collisions to the detector.

Realistic dilepton emission rates and an accurate description of the fireball's space-time evolution are needed to properly describe the contribution of in-medium signals to the dilepton invariant mass spectrum.

In this presentation we will demonstrate how this can be achieved at SIS collision energies. The framework is implemented into the event generator Pluto which is used by the HADES and CBM experiments to produce their hadronic freeze-out cocktails. With the help of an coarse-graining approach to model the fireball evolution and pertinent dilepton rates via a parametrization of the Rapp-Wambach in-medium ρ meson spectral function, the thermal contribution to the spectrum can be calculated. The results also enable us to get an estimate of the fireball lifetime at SIS18 energies.

We thank R. Rapp for providing a parametrization of the Rapp-Wambach spectral function and many fruitful discussions.

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HK 2.6 Mo 15:30 S1/01 A01

Dielectron studies in Pb-Pb collisions with the ALICE experiment during the LHC Run-II — •Oton Vazquez Doce for the ALICE-Collaboration — Excellence Cluster Universe, TUM. Garching, Germany

Electromagnetic radiation is the ideal probe to study the formation of hot and dense matter in heavy ion collisions.

Real and virtual photons are produced in all the stages of the collision, allowing to study the whole system evolution. Moreover, electromagnetic radiation is transparent to the medium bringing information unaffected by final state interactions. By detecting photons and dileptons one can study the system temperature, via the extraction of thermal radiation, and the chiral symmetry restoration that is expected to happen in the deconfined phase via the modification of the spectral functions of vector mesons.

Dielectron studies in particular provide acces to the low p_T region

at colliders, allowing for a differential study in p_T and invariant mass of the electron pair. In this presentation, the status of dielectron measurements in Pb-Pb collisions at centre-of-mass energies per nucleon pair of 5 TeV, recorded at the recent data taking period in December 2015, will be presented.

A study of a further low mass and p_T acceptance increase for dielectron events in ALICE with a reduced magnetic field of 0.2T will be presented as well. Part of the future Pb-Pb run 3 data after the ALICE upgrade may be acquired with such a magnetic field configuration.

HK 2.7 Mo 15:45 S1/01 A01

Charm and beauty contributions in the dilepton invariant mass spectrum in pp collisions measured with ALICE — •Sebastian Scheid, Raphaelle Bailhache, and Harald Appelshäuser for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The main purpose of ALICE at the LHC is to investigate the properties of the deconfined state of strongly-interacting matter, the Quark Gluon Plasma (QGP), produced in high-energy heavy-ion collisions. Since leptons experience negligible final-state interactions, they are well suited to study the properties of the medium. A measurement of the thermal radiation from the QGP in the dielectron intermediate mass region will allow to estimate the medium temperature. In this region the main background is due to correlated semi-leptonic decays of B- and D-Mesons. They have the particularity to have a large decay length of about 500μm for B-Mesons and 100-300μm for D-Mesons. Therefore the reconstructed tracks of heavy-flavour decay electrons do not point to the primary vertex of the collision. Combining the measured distance of closest approach of each single electron into a pair variable DCA_{ee} gives the possibility to separate prompt di-electron pairs from the heavy-quark background.

The analysis in pp collisions allows to study the feasability of extracting the heavy-quark production with the current ITS of ALICE and provides a reference for Pb−Pb collisions. In this presentation, first results on the DCA_{ee} spectra in pp collisions at 7 TeV will be shown and compared to reference distributions from MC simulations.