HK 45: Heavy-Ion Collisions and QCD Phases IX

Time: Wednesday 16:00–17:15 Location: HK-H1

Group Report HK 45.1 Wed 16:00 HK-H1

Vector and Axial-Vector Mesons in Nuclear Matter — •Ralf-Arno Tripolt[1], Tetyana Galatyuk[2,3], Lorenz von Smekal[1,4], Jochen Wambach[2], and Maximilian Wiest[2] — [1]Justus Liebig University Giessen, Germany — [2]TU Darmstadt, Germany — [3]GSI, Darmstadt, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen, Germany

We present recent results on the in-medium spectral functions of the rho(770) vector meson and the a1(1260) axial-vector meson in nuclear matter, as well as on the resulting thermal dilepton rate. As an effective description of the thermodynamics and the phase structure of nuclear matter we use a chiral baryon-meson model, taking into account the effects of fluctuations from scalar mesons, nucleons, and vector mesons within the Functional Renormalization Group (FRG) approach [1]. Our results show strong modifications of the spectral functions in particular near the chiral critical endpoint which suggest an enhanced dilepton yield at lower energies. Such an enhancement is also found in GiBUU transport simulations for C+C at 1A GeV when including effects of chiral symmetry restoration in the kinetic equations for baryon propagation [2]. Our results may therefore well be of relevance for electromagnetic rates in heavy-ion collisions or neutrino emissivities in neutron-star merger events and help to identify phase transitions and the critical endpoint.

[1] R.-A. Tripolt, C. Jung, L. von Smekal, J. Wambach, Phys. Rev. D 104, 054005 (2021)

[2] A. B. Larionov, L. von Smekal, arXiv: 2109.03556

HK 45.2 Wed 16:30 HK-H1

Dielectron physics opportunities with ALICE 3 — •Florian Eisenhut for the ALICE-Collaboration — Goethe University Frankfurt am Main

ALICE 3 is a compact, next-generation multipurpose detector at the LHC planed as a follow-up to the present ALICE experiment. It will provide unprecedented tracking, particle identification and vertexing capabilities down to a few tens of MeV/c with a large rapidity coverage $|\eta| < 4$. At very low p_{T} and invariant mass (m_{ee}) the thermal dielectron production rate in heavy-ion (AA) collisions is expected to be particularly sensitive to the electric conductivity of the medium. At higher dielectron invariant masses, the spectral shape of thermal radiation from the hot hadron gas carries information about the chiral-symmetry restoration mechanisms, among those is the chiral mixing between ρ and a_1 mesons. In the mass region $1.1 < m_{\mathrm{ee}} < 2.7$ GeV/c^2 the spectrum of thermal dielectrons is dominated by dieletrons from the QGP which directly provides a mean to estimate the early temperature of the medium. Finally, an elliptic flow measurement as a function of m_{ee} and pair transverse momentum allows a study of the dynamic of the medium as a function of time.

This talk will present performance studies for dielectron analyses with ALICE 3. The procedure to determine expected uncertainties of the thermal e^+e^- spectra will be presented and a so-called prefilter technique to reduce the combinatoric background will be explained. Furthermore, feasibility studies of the early temperature of the medium via exponential fits of the invariant mass spectra will be shown.

HK 45.3 Wed 16:45 HK-H1

Feasibility Studies of Di-Electron Spectroscopy with CBM at FAIR — •Cornelius Feier-Riesen for the CBM-Collaboration — GSI, Darmstadt, Germany — Justus-Liebig-Universität Gießen, Gießen, Germany

The Compressed Baryonic Matter experiment (CBM) at FAIR is designed to explore the QCD phase diagram at high net baryon densities and moderate temperatures by means of heavy ion collisions with energies from 2-11 AGeV beam energy (Au+Au collisions) and interaction rates up to 10 MHz, provided by the SIS100 accelerator.

Leptons as penetrating probes not taking part in the strong interaction leave the fireball without being modified thus carrying information from the dense baryonic matter. However, di-leptons are rare probes therefore calling for high efficiency and high purity identification capabilities. In CBM, electron identification will be performed by a Ring Imaging Cherenkov Detector (RICH) and by a Transition Radiation Detector (TRD).

In this contribution, feasibility studies of di-electron spectroscopy from low mass vector meson decays will be presented. Special emphasis is put on the experimental challenge to reduce the combinatorial background in order to get a high significance of the extracted di-electron signal.

HK 45.4 Wed 17:00 HK-H1

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

The study of dielectron production is an exceptional tool to disect the evolution of heavy-ion collisions. In peripheral collisions, a clear excess of dielectrons is observed which exceeds the hadronic decay background at low pair momenta. These soft dielectrons can be attributed to coherent interactions of photons originating from electromagnetic fields generated by the highly Lorentz-contracted colliding ions. In more central collisions, the energy densities are sufficient to create a hot and dense medium. Thermal radiation of this medium can be observed as an excess over the hadronic decay cocktail beyond the pion region. For invariant masses above 1.1 GeV/c^2, correlated heavy-flavour hadron decays are expected to dominate the dielectron yield. Their contribution is modified in the medium compared to elementary collisions to an unknown extend. Therefore, a topological separation based on the distance-of-closest approach (DCA) to the primary vertex can be applied to disentangle them from thermal dielectrons.

In this talk, ALICE measurements of dielectron production in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV, will be presented. In peripheral collisions, final results will be compared to theory and measurements at lower energies. In central collisions, the dielectron spectra will be compared to expectations from the hadronic decay cocktail. Finally, a outlook on a DCA analysis in Pb–Pb is given.