HK 50: Heavy-Ion Collisions and QCD Phases VIII

Time: Thursday 15:45–17:15 Location: HS 3 Chemie

HK 50.1 Thu 15:45 HS 3 Chemie

Measurement of elliptic flow v_2 of neutral mesons in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.36 TeV with the ALICE EMCal — •Marvin Hemmer — Institut für Kernphysik, Goethe-Universität Frankfurt

The simultaneous description of the elliptic flow and production rate of direct photons in ultra-relativistic heavy-ion collisions, known as the "direct-photon puzzle", remains a key theoretical challenge. Distinguishing the elliptic flow of direct photons from that of decay photons, primarily from π^0 mesons, requires a precise estimate of π^0 flow. Additionally, studying the flow of various baryons and mesons sheds light on the underlying production mechanisms.

During LHC Run 3, the ALICE experiment recorded 100 times more Pb–Pb collisions than in Run 2, enabling more detailed studies of these phenomena. In ALICE, π^0 mesons can be reconstructed e.g. by detecting their decay photons with the electromagnetic calorimeter (EMCal). In this talk, the first π^0 elliptic flow measurements in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.36$ TeV will be presented.

HK 50.2 Thu 16:00 HS 3 Chemie

First Look at Dilepton Flow in Au+Au collisions at $\sqrt{s_{NN}}$ = 2.23 GeV with HADES* — •Sukyung Kim — Bergische Universität Wuppertal, Wuppertal, Germany

Dileptons are excellent probes for studying the hot, dense hadronic matter created in heavy-ion collisions. Unlike strongly interacting particles, they traverse the medium without interaction, preserving information from all stages of the fireball evolution.

In this contribution, we study the anisotropic flow of dielectrons produced in Au+Au collisions at $\sqrt{s_{NN}} = 2.23$ GeV, recorded by the High Acceptance DiElectron Spectrometer (HADES) at GSI Darmstadt in March 2024. Recent advances in the calibration of the Ring-Imaging Cherenkov (RICH) detector, leveraging its excellent timing precision, have significantly improved electron purity and enabled more accurate reconstruction of dilepton flow.

This talk will focus on the status and first steps towards deriving the elliptic flow coefficient (v_2) for dielectrons.

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HK 50.3 Thu 16:15 HS 3 Chemie

Strangeness fluctuations in the HADES experiment* — •Athira Sreejith — Bergische Universität Wuppertal, Wuppertal, Deutschland

The QCD phase diagram has been actively studied over the years in the experimental, and theoretical domains using e.g. lattice QCD. The fluctuations of conserved charges like electric charge, baryon number, and strangeness are useful probes to study the QCD phase diagram. The experimental study of higher order cumulants provides insights into potential critical behaviour, and is being analysed at different experiments. This work focuses on the analysis of strangeness fluctuations in Ag-Ag collision data at 1.58 AGeV collected with the High Acceptance DiElectron Spectrometer (HADES). HADES is a fixed target experiment at GSI, Darmstadt that investigates the properties of dense baryonic matter at lower energy regimes.

This study aims to extract strangeness fluctuations by means of charged kaons. The low particle yield at the studied low energies presents challenges, necessitating robust methods to address particle misidentification. One such approach is the Identity method, in which the particle identification is based on probabilities rather than hard cuts. This method is implemented in the TIdentity module developed by M. Arslandok and A. Rustamov. This software module is used to conduct a feasibility study which will be the focus of this contribution.
*This work is supported by "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia and BMBF (05P24PX1).

HK 50.4 Thu 16:30 HS 3 Chemie

Investigating dense nuclear matter - resent collective flow results from HADES — •Behruz Kardan for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main

The study of strongly interacting matter under extreme conditions is one of the most important topics in the exploration of Quantum Chromodynamics (QCD). In this talk, we highlight new measurements by HADES, the *High-Acceptance Dielectron Spectrometer* located at the SIS18 at GSI in Darmstadt, which is currently the only experimental setup with the unique ability to measure rare and penetrating probes at the high-μ_B frontier of the QCD phase diagram.

We discuss recent high statistics results on collective flow phenomena in Au+Au and Ag+Ag collisions. Moreover, flow coefficients v_n up to the 6^{th} order are investigated for the first time in this energy regime. Their combined information allows to construct for the first time a full 3D picture of the angular particle emission in momentum space. The multi-differential results for protons and light nuclei will be shown in different centrality classes over a large region of phase space. Furthermore, flow fluctuations, stemming from variations of the emission pattern, are investigated by an event-by-event correlation of flow coefficients.

The data provide essential constraints for theoretical transport models utilised in the determination of the properties of dense baryonic matter, such as its *viscosity* and *equation-of-state* (EOS).

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HK 50.5 Thu 16:45 HS 3 Chemie

Equation of state at finite density from functional methods — •Omar Perez-Figueroa[1], Theo F. Motta[1,2], and Christian S. Fischer[1,3] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany. — [2]Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, Theoriezentrum, Schlossgartenstr. 2 D-64289 Darmstadt, Germany. — [3]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany.

In this short talk, we present first results for a state of the art calculation to obtain the quark-gluon matter pressure at finite chemical potential. To this end we employ Dyson-Schwinger equations (DSE) in a 2+1 flavor scenario that has been tested successfully elsewhere in the QCD phase diagram. The equation of state for quark-gluon matter can be used as input for the hydrostatic equilibrium equation of cold neutron stars. Two paths were explored for the calculations. First, employing an effective action expansion derived by functional methods, the pressure at finite and zero chemical potential can be compared or, second, the number density can be calculated and further integrated to yield the pressure. The latter option has already been proved useful in computing quark and baryon number fluctuations at finite temperature. Both methods are compared and some physical consequences are discussed.

HK 50.6 Thu 17:00 HS 3 Chemie

Determining the Reaction Volume with CBM — •Beatriz Artur — IKF, Goethe-Universität

The main goal of the Compressed Baryonic Matter (CBM) Experiment at FAIR is to probe the QCD phase diagram at high net-baryon densities and moderate temperatures with nucleus-nucleus collisions, in order to locate the possible first order phase transition from hadronic to partonic matter and its critical end point (CEP). The higher moments (cumulants) of conserved quantities, such as baryon number, strangeness and electrical charge, are suggested to be sensitive to the proximity of the CEP. In order to assess the behavior of these cumulants, it is crucial to determine the reaction volume. Indeed, different procedures for centrality selection, based on participant multiplicity with the STS detector or on spectator multiplicity with the new FSD detector, allow us to study reaction volume fluctuations and their impact on net-baryon cumulants. In this work, we explore these different procedures using the hadronic transport models SMASH and PHQMD.