HK 33: Heavy-Ion Collisions and QCD Phases VII

Time: Tuesday 17:30–19:00 Location: HBR 62: EG 05

Group Report HK 33.1 Tue 17:30 HBR 62: EG 05

Production and fluctuation of protons and light nuclear clusters in Ag+Ag reactions measured by HADES — •Marvin Nabroth for the HADES-Collaboration — Goethe-Universität, Frankfurt, Germany

The HADES (High-Acceptance-Dielectron-Spectrometer) experiment at SIS18/GSI measures the reaction products from heavy-ion collisions at kinetic beam energies around 1A GeV. This allows probing the QCD phase diagram at high net-baryon densities and moderate temperatures. The matter formed in such collisions is believed to reach pressures and temperatures as they are expected to occur in binary neutron star mergers. This group report presents the reconstructed phase space distributions of protons and light nuclei in Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55\ GeV$. Furthermore, the focus is put on the analysis of the event-by-event proton (free and bound) multiplicity fluctuations. Covered are techniques for fluctuations analyses based on a Bayesian ansatz (Identity Mehtod), as well as various unfolding methods, employed to account for particle reconstruction inefficiencies. Moreover, the dynamical fluctuations are distorted by the fluctuations of the system size. Hence, a correction procedure that circumvents contributions from the system size fluctuations is also discussed. Higher-order cumulants of net-baryon number distribution are of particular interest as they are sensitive to the vicinity of a phase transition and the potential critical endpoint.
This work has been supported by BMBF (05P21RFFC2), GSI F&E and HFHF.

HK 33.2 Tue 18:00 HBR 62: EG 05

Modeling charged-particle spectra of pp collisions with deep neural networks — •Maria A. Calmon Behling — Institut für Kernphysik, Goethe-Universität Frankfurt

During the data-taking campaigns Run 1 and Run 2 of the Large Hadron Collider (LHC), the ALICE collaboration collected a large amount of proton-proton (pp) collisions across a variety of center-of-mass energies ($\sqrt{s}$). This extensive dataset is well suited to study the energy dependence of particle production. Deep neural networks (DNNs) provide a powerful regression tool to capture underlying multidimensional correlations inherent in the data. In this contribution, DNNs are used to parameterize recent ALICE measurements of charged-particle multiplicity (N_{ch}) distributions and transverse momentum (p_{T}) spectra. These observables are predicted by means of an ensemble method, extrapolating the measurements towards higher N_{ch} and p_{T} values as well as to unmeasured $\sqrt{s}$ from 0.5 to 100 TeV. We demonstrate that the predicted p_{T} spectra can serve as a reference for future heavy-ion measurements, e.g. the O–O campaign planned in LHC Run 3, where no dedicated pp data-taking at the same $\sqrt{s}$ is currently foreseen.

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HK 33.3 Tue 18:15 HBR 62: EG 05

Determining centrality in heavy-ion collisions measured with HADES - A method suitable to compare experimental data and model predictions — •Simon Spies for the HADES-Collaboration — Goethe-Universität Frankfurt

Centrality is a very important concept for the classification of heavy-ion collisions as it is closely correlated to the amount of nucleons participating in the reaction and therefore the size of the emitting particle source. While in transport models the centrality is perfectly determined by the impact parameter, in experimental data one has to rely on observables like amounts of tracks or detector hits in combination with models to estimate the centrality. Therefore, the centrality classes estimated for experimental data are blurred compared to the actual centrality classes, which results in systematic differences when comparing experimental data with model predictions.
In this contribution we compare the emission of protons and light nuclei from Au+Au collisions at $\sqrt{s_{NN}} = 2.42$ GeV and Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV measured by HADES to state-of-the art transport model predictions. Therefore, we apply a newly developed method to reproduce the centrality classes estimated for experimental data in models to eliminate potential systematic differences from the definition of the centrality class estimation.
This work has been supported by BMBF (05P21RFFC2), GSI, HFHF and the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006).

HK 33.4 Tue 18:30 HBR 62: EG 05

Measurement of Net-Proton Fluctuations in Pb-Pb Collisions with ALICE — •Ilya Fokin for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg

Fluctuations of conserved charges, such as the baryon number, are a unique tool to study the phase diagram of strongly interacting matter. Cumulants of distributions of conserved charges in heavy-ion collisions can be related to the equation of state in lattice QCD (LQCD) and thus make the calculations from first principle accessible in the experiment. Recent results from LQCD suggest that in strong magnetic fields, fluctuations of the baryon number might be increased.

In this talk, measurements of the second-order cumulant of the (anti-)proton and net-proton number in Pb–Pb collisions with the ALICE detector at the LHC are presented. The moments of the net-proton number, which are used as a proxy for the baryon number, are calculated using the Identity Method to avoid the problem of misidentification. The new results cover a larger momentum acceptance and the centrality range than previous ALICE measurements of net-proton fluctuations.

HK 33.5 Tue 18:45 HBR 62: EG 05

Neutral pion production in p+p collisions at 1.58 GeV beam energy with the HADES experiment — •Lena Marie Albohn for the HADES-Collaboration — Justus-Liebig-Universität Gießen

In February 2022 p+p collisions with a kinetic beam energy of 1.58 GeV were recorded with the HADES (High Acceptance DiElectron Spectrometer) experiment at the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt, Germany. This measurement is important for providing a p+p reference for the Ag+Ag collisions taken at the same energy in 2019. Dielectrons do not interact strongly and are therefore excellent probes for the hot dense phase of particle collisions. The background of the dielectron spectra at low invariant masses is dominated by Dalitz decays of pions and other neutral mesons. Hence the objective of this work is to calculate the multiplicity of neutral pions in p+p collisions through their decay into two photons detected in the electromagnetic calorimeter. The calculation of this multiplicity is done via a multidifferential analysis of the invariant mass spectra of photon pairs, dependent on transverse momentum and rapidity.