# HK 58: Heavy Ion Collisions and QCD Phases XI

Zeit: Freitag 14:00–16:15 Raum: F 1

**Gruppenbericht** HK 58.1 Fr 14:00 F 1

**Reconstruction of short lived mesons and baryons in HADES** — •Georgy Kornakov for the HADES-Collaboration — Technische Universität Darmstadt

The measurement of hadron properties in hot and dense QCD matter is one of the important goals in nuclear physics. HADES measures rare and penetrating probes in elementary and heavy-ion collisions in the regime of 1 - 2 GeV kinetic energy per nucleon. Throughout the fireball evolution, mesons are mainly produced from the excitation and decay of baryonic resonances. Furthermore, the excited baryons make a significant contribution to the dilepton emission but also play an important role in the production of strange particles. The reconstruction of short-lived ($\sim$1 fm/c) resonance states through their decay products is notoriously difficult. We have developed a new iterative algorithm, which can build the multi-differential background distribution from real data. This allows us to extract signals with signal-to-background ratios below 1%. In this contribution we will demonstrate the performance of the procedure studying inclusive $\pi p$ and $\pi\pi$ final states in pion-induced reactions. Then, the differential spectra measured in Au+Au collisions at 1.23 AGeV will be discussed. Apparent resonances mass shifts and broadening as a function of centrality and transverse momentum will be elaborated. This work has been supported by TU Darmstadt: VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI.

HK 58.2 Fr 14:30 F 1

**Many-body reactions in baryon-antibaryon annihilation including strangeness** — •Eduard Seifert and Wolfgang Cassing — Intitut für Theoretische Physik, JLU Gießen, Deutschland

We study the impact of baryon-antibaryon annihilation into three mesons on heavy-ion collisions. The reactions are based on the quark rearrangement model in the light and strange sector. Box simulations with periodic boundary conditions confirm that our implementation of these reactions fulfills the detailed balance relation on a channel by channel basis. We implement these reactions into the Parton Hadron String Dynamics (PHSD) transport model and investigate their importance for different bombarding energies in Pb+Pb and Au+Au collisions. We find a significant impact on antibaryons as their total abundance is low and sensitive to the introduced reactions.

HK 58.3 Fr 14:45 F 1

**Reconstruction of short-lived particles with neutral daughter by the missing mass method** — Ivan Kisel[1,2,3], •Pavel Kisel[1,3,4], Peter Senger[3], Iouri Vassiliev[3], and Maksym Zyzak[3] for the CBM-Collaboration — [1]Goethe-Universität Frankfurt — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Joint Institute for Nuclear Research

The main goal of modern heavy-ion experiments is a comprehensive study of the QCD phase diagram, in a region of Qaurk-Gluon Plasma (QGP) and possible phase transition to QGP phase.

One of possible signals of QGP formation is enhanced strangeness production. Reconstruction of $\Sigma$ particles together with other strange particles completes the picture of strangeness production. $\Sigma+$ and $\Sigma-$ have all decay modes with at least one neutral daughter, which can not be registered by the CBM detector.

For their identification the missing mass method is proposed: a) tracks of the mother ($\Sigma$-) and the charged daughter ($\pi$-) particles are reconstructed in the tracking system; b) the neutral daughter particle (n) is reconstructed from these tracks; c) a mass constraint is set on the reconstructed neutral daughter; d) the mother particle is constructed of the charged and reconstructed neutral daughter particles and the mass spectrum is obtained, by which the particle can be identified.

The method can be applied for other strange particles too. In total 18 particle decays with neutral daughter are now included into physics analysis.

HK 58.4 Fr 15:00 F 1

**Nuclear Matter with Fluctuations beyond Local Potential Approximation** — •Johannes Weyrich and Lorenz von Smekal — JLU Gießen

We describe the liquid-gas transition of nuclear matter together with chiral symmetry restoration in the high baryon-density phase considering a chiral baryon-meson model for nucleons and their parity partners in mirror assignment interacting with pions, sigma and omega mesons. Beyond mean-field fluctuations have been included within the functional renormalization group in the local potential approximation (LPA) and do not lead to major qualitative changes in the phase diagram of the model. A clear first-order chiral transition at low temperatures inside the high baryon-density phase appears to be robust. An extension beyond LPA including scale dependent wave function renormalization factors for baryons and mesons is an important step towards developing a quark-meson-baryon model for a more realistic description of nuclear matter and the transition to chiral quark matter.

HK 58.5 Fr 15:15 F 1

**Event-by-Event Fluctuations of the Mean Transverse Momentum in pp, p–Pb and Pb–Pb Collisions with ALICE** — •Stefan Heckel for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Event-by-event mean transverse momentum ($p_{\mathrm{T}}$) fluctuations in pp and Pb–Pb collisions have been measured by ALICE at the LHC [1]. In both systems, non-statistical fluctuations relative to mean $p_{\mathrm{T}}$ are observed which decrease with increasing multiplicity following the same power-law like behaviour up to mid-central Pb–Pb collisions. In central Pb–Pb, a strong reduction of the fluctuations is observed.

In the present analysis, also p–Pb collisions are studied as a function of multiplicity, where a similar trend to that of pp and Pb–Pb collisions is observed. The results are examined in terms of a transition from small to large collision systems and compared to model calculations.

Supported by BMBF and the Helmholtz Association.

[1] ALICE Collaboration, B. Abelev et al., Eur. Phys. J. C **74** (2014) 3077. arXiv:1407.5530 [nucl-ex]

HK 58.6 Fr 15:30 F 1

**Higher-Order Moments of Proton-Number Fluctuations in Au+Au Collisions at 1.23A GeV with HADES** — •Melanie Szala for the HADES-Collaboration — Goethe Universität Frankfurt

Higher-order moments of conserved quantities are predicted to be sensitive to a first order phase transition and especially to a critical point of the QCD phase diagram. Strong fluctuations would indeed modify these moments.

The HADES experiment at GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt measured Au+Au collisions at $\sqrt{s_{NN}} = 2.41$ GeV in 2012 and thus allows to extend the data taken in the RHIC Beam Energy Scan to lower energies.

In this talk we present investigations of the higher moments of proton and deuteron multiplicity distributions. Our results are compared with published RHIC data.

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HK 58.7 Fr 15:45 F 1

**Centrality and pseudorapidity dependence of identified-particle ratio fluctuations in Pb–Pb collisions in ALICE** — •Mesut Arslandok for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg, Germany

We report on event-by-event fluctuations of identified particles in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$=2.76 TeV, recorded by the ALICE detector at the CERN LHC. The ALICE detector is well-suited for such studies due to its excellent particle identification capabilities. The first results on identified particle ratio fluctuations in Pb–Pb collisions as a function of centrality and pseudorapidity are presented. The results for the peripheral events indicate an increasing correlation between pions and protons which is not reproduced by the HIJING and AMPT models. On the other hand, for the most central events the ALICE results agree with the extrapolations based on the data at lower energies from the CERN-SPS and BNL-RHIC.

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HK 58.8 Fr 16:00 F 1

**Color transparency in semiexclusive $A(\pi^-, l^+l^-)$ process** — •Alexei Larionov[1], Mark Strikman[2], and Marcus Bleicher[3,4]

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Color transparency (CT) phenomenon is known as a suppression of the interaction of small color singlet $q\bar{q}$ or $qqq$ configurations with nucleons. The CT is expected when the quark configuration was created in a large momentum transfer process. Apart from being of interest by itself as a genuine QCD effect, the observation of CT in the processes with nuclear targets is a necessary condition for the corresponding elementary process to be describable within the factorization technique. In this talk we consider the possible CT effect in the semiexclusive $A(\pi^-, l^+l^-)$ process at $p_{\rm lab} = 15 - 20$ GeV/c at small $|t|$ and large invariant mass of the dilepton pair $l^+l^-$ [1]. Based on the size of the pionic $q\bar{q}$ configuration extracted from the semiexclusive $A(e, e'\pi^+)$ process measured at JLab, we predict very significant CT effects in $A(\pi^-, l^+l^-)$ reaction. The observation of these CT effects would provide an additional confidence on the possibility to extract the generalized parton distributions of the nucleon from the elementary reaction $\pi^- p \to l^+l^- n$ at similar kinematics.

[1] A.B. Larionov, M. Strikman, M. Bleicher, Phys. Rev. C **93** (2016) 034618; arXiv:1601.00189