HK 9: Heavy Ion Collisions and QCD Phases II

Zeit: Montag 16:30–18:30 Raum: HZO 60

Gruppenbericht HK 9.1 Mo 16:30 HZO 60

Final state hadron chemistry and kinematic distributions in Au+Au collisions at $\sqrt{s_{NN}} = 2.42$ GeV with HADES — •Malgorzata Gumberidze for the HADES-Collaboration — TU Darmstadt

The matter formed in central heavy-ion collisions at a few GeV per nucleon is commonly understood as resonance matter, a gas of nucleons and excited baryon states with a substantial contribution from mesonic, mostly pionic excitations. Yet, in the initial phase of the reaction the system is compressed to densities several times larger than the normal nuclear matter density density and temperatures of about 80 MeV. At such extreme conditions the fundamental properties of the hadrons are expected to be modified.

The High Acceptance DiElecton Spectrometer (HADES), installed at heavy-ion synchrotron SIS18 at the GSI Helmholtzzentrum für Schwerionenforschung (Germany), is currently the only experiment studying properties of strongly interacting matter in a few A GeV energy regime. It studies dielectron and hadron production in heavy-ion collisions, as well as in proton- and pion-induced reactions in the energy range of 1 - 4 GeV.

In this contribution the yields and spectra of a comprehensive set of hadrons (p, $\pi^{\pm}$, $K^{\pm}$, ϕ, Λ) produced in Au+Au collisions at $\sqrt{s} = 2.42$ GeV will be presented. The high statistics data allows for studying multi-differential distributions. Experimental spectra will be confronted with results obtained by other experiments as well as with available model calculations.

HK 9.2 Mo 17:00 HZO 60

Strangeness production via resonances in nucleus-nucleus collisions — •Vinzent Steinberg[1,2], Jan Staudenmaier[1,2], Feng Li[2], and Hannah Petersen[1,2,3] — [1]Institute for Theoretical Physics, Goethe University, Franfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The production of strange particles in heavy-ion collisions is enhanced compared to elementary reactions with particularly interesting results on the ϕ meson production close to the threshold by the HADES collaboration at GSI-SIS energies. In this talk, SMASH (Simulating Many Accelerated Strongly-interacting Hadrons), a new hadronic transport approach designed to describe the non-equilibrium evolution of heavy-ion collisions, is applied to investigate the production of strange particles. The production mechanism via resonances is constrained by experimental data from elementary collisions and can describe strangeness production in small systems. To describe large systems, in-medium effects may be important.

HK 9.3 Mo 17:15 HZO 60

The effect of finite particle number sampling on baryon number fluctuations — •Jan Steinheimer[1] and Volker Koch[2] — [1]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Str. 1, 60438 Frankfurt am Main, Germany — [2]Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA

In this talk we discuss the effects of finite particle number sampling on the net baryon number cumulants, extracted from fluid dynamical simulations of nuclear collisions. The commonly used finite particle number sampling procedure introduces an additional Poissonian (or multinomial if global baryon number conservation is enforced) contribution which increases the extracted moments of the baryon number multiplicity distribution. If this procedure is applied to a fluctuating fluid dynamics framework one severely overestimates the actual cumulants. It will be shown that the sampling of so called test-particles suppresses the additional contribution to the moments by at least one power of the number of test-particles. The method will be demonstrated for a numerical fluid dynamics simulation that includes the effects of spinodal decomposition due to a first order QCD phase transition in heavy ion collisions. Furthermore, in the limit where anti-baryons can be ignored, we derive analytic formulas which capture exactly the effect of particle sampling on the baryon number cumulants. These formulas may be used to test the various numerical particle sampling algorithms.

This talk is based on: J.Steinheimer and V.Koch, Phys. Rev. C 96, no. 3, 034907 (2017).

HK 9.4 Mo 17:30 HZO 60

Integration of cosmic muons in the Bethe-Bloch parametrization with the ALICE TPC — •Matthias Kleiner for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) is the main tracking and particle identification detector of the ALICE experiment at the CERN LHC. The specific energy loss ($\mathrm{d}E/\mathrm{d}x$) of particles traversing the TPC is parametrized in the ALICE analysis framework AliROOT by a Bethe-Bloch function. At present, the function is fitted using clean samples of electrons, protons and pions. However, none of these particles have a velocity in the region of the relativistic rise up to the Fermi plateau. In this talk, a new method is presented which includes the cosmic muons $\mathrm{d}E/\mathrm{d}x$ to the parametrization. The quality of the new parametrization is studied and compared to the parametrization obtained without muons. Supported by BMBF and Helmholtz Association.

HK 9.5 Mo 17:45 HZO 60

Recent event-by-event net-particle fluctuation results from ALICE — •Mesut Arslandok for the ALICE-Collaboration — Physikalisches Institut Heidelberg

The fluctuations of conserved charges - such as electric charge, strangeness, or baryon number - in ultrarelativistic heavy-ion collisions provide insights into the properties of hot and dense matter produced as well as the QCD phase diagram. They can be related to the moments of the multiplicity distributions of identified particles. In this context, experimental results will be presented on event-by-event analysis of net baryon fluctuation measurements in Pb–Pb collisions recorded by the ALICE Collaboration at the CERN LHC. In addition to net-protons, used as a proxy for net-baryons, similar results for net-pions and net-kaons will be presented. Contributions from participant fluctuations and resonances as well as baryon number conservation will be discussed. Particular emphasis will be placed on the quantitative understanding of the centrality and rapidity width dependence of the obtained results. The data will be compared with recent predictions from the Hadron Resonance Gas model (HRG) and Lattice QCD (LQCD).

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HK 9.6 Mo 18:00 HZO 60

Perspectives on strangeness physics with the CBM experiment at FAIR — •Iouri Vassiliev[1], Maksym Zyzak[1], and Ivan Kisel[2,3] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]Frankfurt Institute for Advanced Studies — [3]Goethe-Universität Frankfurt

The main goal of the CBM experiment at FAIR is to study the behavior of nuclear matter at very high baryonic density in which the transition to a deconfined and chirally restored phase is expected to happen. One of the promising signatures of this new states are the enhanced production of multi-strange particles. The CBM detector is designed to measure such rare diagnostic probes with unprecedented precision and statistics. Important key observables are the production of hypernuclei and dibaryons. Theoretical models predict that single and double hypernuclei, and heavy multi-strange short-lived objects are produced via coalescence in heavy-ion collisions with the maximum yield in the region of SIS100 energies. The discovery and investigation of new hypernuclei and of hyper-matter will shed light on the hyperon-nucleon and hyperon-hyperon interactions. Feasibility studies of these key observables in the CBM experiment are presented.

HK 9.7 Mo 18:15 HZO 60

Application of Cellular Automaton track finder in TPC detectors — •Grigory Kozlov[1,2], Yuri Fisyak[3], Ivan Kisel[1,4], and Maksim Zyzak[4] for the CBM-Collaboration — [1]FIAS, Frankfurt am Main, Germany — [2]JINR, Dubna, Russia — [3]BNL, Upton, USA — [4]GSI, Darmstadt, Germany

Track finding procedure is one of the key step of events reconstruction in high energy physics experiments. Track finding algorithms combine hits into tracks and reconstruct trajectories of particles flying through the detector. The problem of combining hits into particle trajectories is considered as an extremely time consuming task because of large combinatorics. Thus, calculation speed is crucial in heavy ion experiments. The Cellular Automaton (CA) algorithm provides a perfect solution for this task. Being intrinsically parallel, it can be massively parallelised on the modern many core computing platforms keeping high track reconstruction efficiencies even in case of high particle multiplicity. The CA track finder algorithm was investigated in application to the TPC CA track finder in the STAR experiment within the FAIR Phase 0 as a part of preparation to the Beam Energy Scan II (BES II) program. The track finder is being prepared to operate in the online mode, thus, requires maximum possible speedup. To achieve these goal the data structures were improved for better SIMDisation and parallelisation, the implementation was optimised utilising the locality of the CA algorithm. As a result, higher speed is achieved with the reconstruction efficiency being the same.