HK 53: Heavy Ion Collisions and QCD Phases 6

Time: Thursday 14:30–16:30 Location: T/HS1

Group Report HK 53.1 Thu 14:30 T/HS1

(Anti-)nuclei production and exotica searches with ALICE at the LHC — •Benjamin Dönigus for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt, Frankfurt, Germany

The high collision energies reached at the LHC lead to significant production yields of light anti- and hyper-nuclei in proton-proton and, in particular, Pb-Pb collisions. The excellent particle identification capabilities from the Time Projection Chamber, using the specific energy loss (dE/dx), and the time-of-flight measurement, allow for the detection of these rarely produced particles. Further the Inner Tracking System gives the possibility to seperate primary nuclei from those coming from the decay of heavier systems. This altogether offers the unique opportunity to search for exotica like the bound state of a Λ and a neutron which would decay into deuteron and pion, or the bound state of two Λs, and also allows for the topological identification of the hyper-triton via its mesonic decay ($^3_\Lambda$H $\rightarrow$^{3}He+π).

In this group report we will show results for (anti-)deuterons, (anti-)tritons, (anti-)^{3}He and (anti-)^{4}He and give an overview on the ongoing searches. The results will also be compared with the expectations from thermal and coalescence models.

HK 53.2 Thu 15:00 T/HS1

Anti-Alpha production in $\sqrt{s_{NN}} = 2.76$ TeV Pb–Pb collisions with ALICE at the LHC — •Nicole Löher for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum fürSchwerionenforschung, Planckstraße 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

ALICE is the experiment at the CERN LHC dedicated to the investigation of nucleus–nucleus collisions at the highest energies ever reached in the laboratory. The excellent particle identification capabilities allow for the measurement of many particle species, spanning a wide range in mass, from the light electrons to the heavy ^{4}He nuclei. In this talk we present results from a sample of Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV. The anti-alpha is the heaviest anti-nucleus observed up to now. These particles have been identified based on their specific energy loss in the Time Projection Chamber and the velocity information from the Time-Of-Flight detector. The production yield dN/dy is presented and the result is compared with thermal model calculations.

HK 53.3 Thu 15:15 T/HS1

Searching for a Dark Photon with HADES — •Carina Ungethuem for the HADES-Collaboration — TU Darmstadt

Approximately 25 % of our universe consists of dark matter (DM). It is possible that the DM (DM) interacts with the visible matter via a U(1) gauge boson, the so called U-boson (A', γ' or dark photon). The standard model (SM) is thereby supplemented with an additional sector characterized by the U(1)' symmetry, which gives the counterpart to the SM U(1) symmetry. The kinetic mixing of the U(1) and U(1)' symmetry groups gives a natural connection between the SM and DM. The dark photon is constrained to be in the MeV to GeV range and should have a small width of $\Gamma_u \ll 1$ MeV/c^2. Such models are also proposed to explain some recent puzzling astrophysical observations, as well as to solve the sofar unexplained deviation between the measured and calculated values of the muon anomaly. We present a search for the e$^+$e$^-$ decay of such a hypothetical dark photon in inclusive dielectron spectra measured by HADES in the Au (1.23 GeV) + Au reaction. An upper limit on the kinetic mixing parameter at 90% CL has been obtained for a mass range lower than 0.6 GeV/c^2 and is compared with the present world data set. We are aiming at a lowering of the upper limit for masses below 0.1 GeV/c^2 in order to exclude a further part of the parameter region favored by the muon g-2 anomaly.

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HK 53.4 Thu 15:30 T/HS1

Deep sub-threshold strangeness production in nuclear collisions with the UrQMD transport model — •Jan Steinheimer[1], Gunnar Graef[1], Feng Li[3], and Marcus Bleicher[1,2] — [1]FIAS, Frankfurt am Main — [2]ITP, Goethe Universität, Frankfurt am Main — [3]Texas *A&M* University, College Station, USA

I will present results on deep sub threshold strangeness production in nuclear collisions, with the UrQMD transport model. Introducing anti-kaon+baryon and hyperon+hyperon strangeness exchange reactions we obtain a good description of experimental data on single strange hadron production in Ar+KCl reactions at $E_{lab} = 1.76$ A GeV. We find that the hyperon strangeness exchange is the dominant process contributing to the Ξ^- yield, however remains short of explaining the large Ξ^-/Λ ratio measured with the HADES experiment while agreeing well with a thermal fit to the data. I will further discuss open problems in the microscopic description of strangess production at SIS18 energies, including the surprisingly high ϕ/K^- ratio measured with the HADES experiment as well as uncertainties arising from unknown resonance branching ratios.

HK 53.5 Thu 15:45 T/HS1

A new approach to detect hypernuclei in the QMD/HSD phase space distribution at relativistic energies — •Arnaud Le Fèvre[1], Yvonne Leifels[1], Jörg Aichelin[2], Christoph Hartnack[2], Elena Bratkovskaya[3], and Victor Kyreyev[4] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]SUBATECH, UMR 6457, Ecole des Mines de Nantes - IN2P3/CNRS - Université de Nantes, France — [3]FIAS, Francfort University, Germany — [4]JINR, Dubna, Russia

We developed an improved clusterisation algorithm which aims at predicting more realistically the yields of clusters in the framework of the Quantum Molecular Dynamics model. This new approach is able to predict isotope yields as well as hypernucleus production at relativistic energies. To illustrate its predicting power, we confront this new method to experimental data, with a close view on light hypernucleus yields and phase space distributions, and show the sensitivity on the parameters which govern the hypercluster formation, such as the hyperon-nucleon cross-section, the clusterisation time, the initial momentum distribution of nucleons and the asymmetry energy.

HK 53.6 Thu 16:00 T/HS1

Fast reconstruction of multi-strange hyperons in the CBM experiment — •Iouri Vassiliev for the CBM-Collaboration — GSI, Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The main goal of the CBM experiment is to study the behaviour 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 promissing signatures of this new state is the enhanced production of multi-strange particles, therefore the reconstruction of multi-strange hyperons is essential for the understanding of the heavy ion collision dynamics. Another experimental challenge of the CBM experiment is online selection of open charm particles via the displaced vertex of the hadronic decay, Charmonium and low mass vector mesons in the environment of a heavy-ion collision. This task requires fast and efficient track reconstruction algorithms, primary vertex finder and particles finder. Results of feasibility studies of the multi-strange hyperons in the CBM experiment will be presented.

HK 53.7 Thu 16:15 T/HS1

Towards a Realistic Event Generator for In-Medium Signals — •Florian Seck for the HADES-Collaboration — TU Darmstadt

The most important task of theoretical heavy-ion physics is to link experimental observables to the bulk properties and the microscopic structure of the different phases of strongly interacting matter.

Until now the hadronic cocktails produced with the event generator Pluto for the HADES and CBM experiments only included a contribution from freeze-out ρ mesons modeled by a Breit-Wigner distribution around its pole mass.

However as dileptons are radiated from the fireball during the whole time evolution, medium effects like the broadening of the ρ should also be included in the simulations. Calculations of the in-medium ρ spectral function by R. Rapp and J. Wambach demonstrate, that a large part of the in-medium ρ mesons feed into the mass region below the ρ/ω pole mass down to zero masses.

The modular structure of Pluto makes it feasible to customize the event generator and incorporate models of in-medium physics, like the Rapp-Wambach spectral function, as plug-ins. For masses above

1 GeV/c^2 we include emission due to multi-pion annihilation and due to QGP radiation.

In this contribution first steps towards the implementation of such a plug-in into the event generator Pluto are presented.

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