HK 35: Heavy-Ion Collisions and QCD Phases VIII

Time: Wednesday 16:30–18:30 Location: J-HS G

Group Report HK 35.1 Wed 16:30 J-HS G

Protons and Light Nuclei from Au+Au Collisions at $\sqrt{s_{NN}} = 2.4$ GeV measured with HADES — •Melanie Szala for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main, Germany

The HADES experiment at the SIS18 accelerator of the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt measured Au+Au collisions at 1.23A GeV.
In this energy regime protons make up the bulk of the produced particles, yet a large fraction of them (≈40%) are bound in light nuclei.

With the goal to unterstand the created system in heavy-ion collisions in this energy regime and the production mechanism of these nuclei, we present the results of p, d, t and ^{3}He. The production of nuclei in heavy ion collisions is commonly discussed within two different scenarios: the thermal-statistical hadronization models and the coalescence model. We will compare our data to state of the art models and compare the results to those in heavy-ion collisions at higher energies.

This work has been supported by BMBF (05P19RFFCA), GSI and HIC for FAIR.

HK 35.2 Wed 17:00 J-HS G

Deuteron production in Au-Au collisions at 1.23A GeV in SMASH — •Martha Ege[2,3], Justin Mohs[1,2,3], and Hannah Elfner[1,2,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [2]Institute for Theoretical Physics, Goethe University Frankfurt am Main — [3]Frankfurt Institute for Advanced Studies, Frankfurt am Main

For nuclear physics it is of big interest to get a better understanding about how light nuclei are formed in heavy-ion collisions. In this work we investigate the production of deuterons at $E_{lab} = 1.23$A GeV. We study light nuclei production in the framework of a hadronic transport approach called SMASH. In this approach deuterons are implemented as degrees of freedom. This approach has been successfully applied in an afterburner calculation at LHC energies. In this work, the exact same approach is applied to low beam energy collisions, where the whole evolution is described with hadronic transport approaches. We investigate the dynamics of the produced deuterons by calculating flow coefficients and spectra and compare them to the results for protons under the same conditions. For comparison the same calculations are performed using coalescence instead of propagating the deuteron in SMASH. The results are compared to recent experimental data from the HADES collaboration. The most important reactions for deuteron production are determined.

HK 35.3 Wed 17:15 J-HS G

Application of the 3-Fluid Hydrodynamic Event Generator THESEUS to CBM — •Elena Volkova for the CBM-Collaboration — Tuebingen University, Germany

The Compressed Baryonic Matter experiment (CBM) at FAIR will measure nucleus-nucleus collisions at beam energies up to 11 AGeV for Au. The key objective of CBM is to investigate the QCD phase diagram in the region of the highest net-baryon-densities. The experiment is well suited to explore the Equation-of-State of nuclear matter at densities as they might occur in the interior of neutron stars or during neutron star mergers.

The new generator THESEUS for heavy ion collisions describes the whole evolution of the system which begins with the fireball creation, its expansion and ends with free-streaming particles, which can be accounted for in event based simulations. The generator based on hydrodynamics and thus requires, and equation of state(EoS). It is possible to choose between 3 different scenario: 1st order phase transition, crossover and pure hadron gas. A status of various for the analysis for various observables(rapidity distributions. transverse mass spectra) employing different EoS with and without CBM detector will be presented. We will discuss an effect on observables and the ways to possibly distinguish between different EoS.

HK 35.4 Wed 17:30 J-HS G

Reconstruction of tracks with very low momentum in TPC detector — •Grigory Kozlov[1,2], Ivan Kisel[1,3,4], and Yuri Fisyak[5] for the CBM-Collaboration — [1]Goethe-Universität, Frankfurt, Germany — [2]JINR, Dubna, Russia — [3]FIAS, Frankfurt, Germany — [4]GSI, Darmstadt, Germany — [5]BNL, Upton, USA

Within the CBM Phase-0 we develop and study the Cellular Automaton (CA) track finder in the iTPC detector of the STAR experiment (RHIC, BNL). The Beam Energy Scan BES-II program at STAR will explore region of the QCD phase diagram with energies 7.7-19.6 GeV (collider) and 3.0-7.7 GeV (fixed-target), which poses new challenges for the tracking algorithm. Collision of beam at these energies in STAR leads to production of particles with very low momenta. Such particles move parallel to the beam axes along spiral trajectories that significantly complicates the operation of the TPC detector, especially in fixed target (FXT) mode, as well as the eTOF detector (CBM TOF). Reconstruction of such loopers is a difficult task, as the used track model allows to reconstruct them only in the form of a set of segments of a helical trajectory. Increasing the number of pad rows in the iTPC detector has made the number of measurements in segments sufficient to find them locally using the CA algorithm. Therefore an additional procedure to merge the reconstructed segments into long loopers has been developed. The algorithm thus allows to increase the acceptance of TPC for low momentum tracks which is especially important for particle identification with eTOF in the FXT program. The CA algorithm and the results of its application are presented and discussed.

HK 35.5 Wed 17:45 J-HS G

Measurement of (anti-)^{3}H and (anti-)^{3}He production in pp collisions at $\sqrt{s} = 13$ TeV — •Michael Habib for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik Technische Universität Darmstadt, Schlossgartenstr. 9, 64289 Darmstadt

The formation of light (anti-)nuclei in high-energy hadronic collisions is not understood and under debate in the scientific community. Recent experimental results indicate that the dominant production mechanism seems to evolve smoothly with the charged-particle multiplicity which is related to the size of the system created in the collision.

In this talk, the measurement of the (anti-)^{3}H and (anti-)^{3}He production in pp collisions at $\sqrt{s} = 13$ TeV as a function of multiplicity will be presented. The results are compared with the predictions from the canonical statistical hadronization model and the coalescence approach, which assume very different production mechanisms. The relevance of this measurement for direct searches of dark matter in space experiments will also be discussed.

HK 35.6 Wed 18:00 J-HS G

Elliptic and triangular flow of light (anti-)nuclei in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV — •Alberto Calivà for the ALICE-Collaboration — GSI, Planckstraße 1, 64291 Darmstadt

The production of light (anti-)nuclei in ultrarelativistic heavy-ion collisions and their survival to temperatures exceeding their typical binding energy by almost two orders of magnitude are still not understood and under debate. The radial and azimuthal flow of light (anti-)nuclei are key observables to test the phenomenological models used to describe their production mechanism and to study the dynamics of the interactions in the post-hadronization phase.
In this presentation, the recent results on the elliptic and triangular flow of (anti-)deuteron and (anti-)^{3}He measured by ALICE in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV will be presented.

HK 35.7 Wed 18:15 J-HS G

Production of (anti-)t and (anti-)^{4}He in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE at the LHC — •Esther Bartsch for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The high collision energies reached at the LHC lead to significant production yields of light (anti-)nuclei in proton-proton and, in particular, Pb–Pb collisions. The excellent particle identification capabilities of the ALICE 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.

Recent results on (anti-)triton and (anti-)^{4}He production in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV will be presented and compared to coalescence and statistical hadronization models to provide insight into their production mechanism in heavy-ion collisions.

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