# HK 43: Heavy-Ion Collisions and QCD Phases X

Time: Thursday 14:00–15:45 Location: J-HS F

**Group Report** HK 43.1 Thu 14:00 J-HS F

**Measurement of the production of light (hyper-)nuclei and their antiparticles with ALICE at the LHC** — •Sebastian Hornung for the ALICE-Collaboration — Ruprecht-Karls-Universität, Heidelberg, Deutschland — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

The production mechanism of (anti-)nuclei and (anti-)hypernuclei in high-energy hadronic collisions is one of the open puzzles in high-energy physics. On the one hand, the yields can be described by statistical hadronization models. On the other hand, the production of nuclei can be explained by the coalescence of protons and neutrons which are close by in phase space. Studies of the light (anti-)nuclei production as a function of the charged-particle multiplicity density provide an important insight into the system-size dependence of the formation of multi-baryon states. The information drawn from the yields and spectra are complemented by the measurement of the momentum space anisotropies in the emission of nuclei. Further, the measurements of the lifetime and binding energy of (anti-)hypertriton can be used to study the interaction of hyperons with nucleons.

The measurement of (hyper-)nuclei is experimentally challenging due to the low production rates and the contamination by secondary nuclei produced in spallation reactions with the beam pipe or the detector material. An overview of recent ALICE results on the production of light (anti-)nuclei and the lifetime of (anti-)hypertriton will be presented.

HK 43.2 Thu 14:30 J-HS F

**Investigations on light (anti-)hypernuclei with ALICE at the LHC** — •Janik Ditzel for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität, Frankfurt, Germany

At the Large Hadron Collider at CERN copious production of light (anti-)(hyper-)nuclei has been measured in Pb–Pb collisions by the ALICE Collaboration. The production of such (anti-)(hyper-)nuclei has recently become a topic of high interest, connecting for instance to the possible strangeness content in neutron stars. The excellent performance of the Inner Tracking System, the Time Projection Chamber and the Time-Of-Flight detector of the ALICE apparatus provide a clear particle identification and vertex reconstruction. ALICE is currently performing its upgrade of the detector setup to cope with the interaction rate of 50 kHz in Pb–Pb collisions in Run 3. This will lead to an even larger sample of light (anti-)(hyper-)nuclei. These (anti-)(hyper-)nuclei are reconstructed by their decay products, e.g. in the charged two-body decay channel of the lightest known (anti-)(hyper-)nucleus ${}^{3}_{\Lambda}\mathrm{H} \rightarrow {}^{3}\mathrm{H} + \pi^{-}$. In order to predict the yields of the (anti-) ${}^{3}_{\Lambda}\mathrm{H}$ and also (double-)(anti-)(hyper-)nuclei of mass number A=4 and A=5, it is essential to study the acceptance and efficiency in Monte Carlo simulations. For the measurement, a magnetic field is needed and currently by default set to B = 0.5 T. We show, that a lower value of the magnetic field provides a better reconstruction efficiency of (anti-)(hyper-)nuclei. In addition, we present the status of our new investigations on the ${}^{4}_{\Lambda\Lambda}\mathrm{H}$ with Run 2 Data.

HK 43.3 Thu 14:45 J-HS F

**Feasibility Study of Hypernuclei Production in CBM at FAIR** — •Anton Lymanets for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The main goal of the CBM experiment at FAIR is to study the behavior of nuclear matter at very high baryonic density. This includes the exploration of the high density equation of state, search for the transition to a deconfined and chirally restored phase, critical endpoint. One of the promising diagnostic probes for these new states is the enhanced production of multi-strange (anti-)particles. The CBM detector is designed to measure such rare diagnostic probes multi-differentially with unprecedented precision and statistics. Important key observables are the production of hypernuclei and dibaryons. Theoretical models predict that single and even doubly-strange hypernuclei are produced in heavy-ion collisions with the maximum yield in the region of SIS100 energies. The discovery and investigation of new (doubly strange-)hypernuclei and of hyper-matter will shed light on the hyperon-nucleon and hyperon-hyperon interactions. In this talk, we will report the results of feasibility study on the production of single- and double-strange hypernuclei in CBM experiment. Implications on the high baryon density nuclear matter will be discussed.

HK 43.4 Thu 15:00 J-HS F

**Nucleosynthesis in heavy-ion collisions at the LHC via the Saha equation** — Volodymyr Vovchenko[1,2], •Kai Gallmeister[1], Jürgen Schaffner-Bielich[1] und Carsten Greiner[1] — [1]Institut für Theoretische Physik, Goethe Universität, Frankfurt/Main — [2]Frankfurt Institute of Advanced Studies, Frankfurt/Main

The production of light (anti-)(hyper-)nuclei in heavy-ion collisions at the LHC is considered in the framework of the Saha equation, making use of the analogy between the evolution of the early universe after the Big Bang and that of "Little Bangs" created in the lab. Assuming that disintegration and regeneration reactions involving light nuclei proceed in relative chemical equilibrium after the chemical freeze-out of hadrons, their abundances are determined through the famous cosmological Saha equation of primordial nucleosynthesis and show no exponential dependence on the temperature typical for the thermal model. A quantitative analysis, performed using the hadron resonance gas model in partial chemical equilibrium, shows agreement with experimental data of the ALICE collaboration on d, ${}^{3}$He, ${}^{3}_{\Lambda}$H, and ${}^{4}$He yields for a very broad range of temperatures at $T \lesssim 155$ MeV. The presented picture is supported by the observed suppression of resonance yields in central Pb–Pb collisions at the LHC.

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HK 43.5 Thu 15:15 J-HS F

**RootInteractive on n-dimensional analysis pipeline** — •Alperen Yüncü for the ALICE-Collaboration — Universität Heidelberg, Heidelberg, Deutschland

Multi-dimensional problems require multidimensional analysis, since the analysis of a projection on a single dimension may cause misinterpretations of the data. Thus, in multidimensional analysis, interactive multidimensional projections can be quite effective to observe the data from various viewpoints. In this contribution, an interactive visualization tool, called RootInteractive, which is currently being used in the physics analysis and calibration processes in ALICE experiment, will be presented.The usage of the tool will be demonstrated on the n-dimensional analysis pipeline of the ALICE experiment, which includes n-dimensional histogramming package, statistical maps extraction, local regression, and machine learning techniques.

HK 43.6 Thu 15:30 J-HS F

**Tracking QA and search for primary vertices** — •Artemiy Belousov[1], Yuri Fisyak[3], Ivan Kisel[1,2], and Maksym Zyzak[1] for the CBM-Collaboration — [1]FIAS, Germany — [2]GSI, Germany — [3]Brookhaven National Laboratory, USA

Modern experiments in high energy physics tend to increase the amount of data to be processed, thus, the execution speed of the algorithms becomes crucial. However, the efficiency and precision of the applied procedures cannot be compromised. Therefore, the Kalman filter method is usually used as a basis in particle tracks reconstruction, since it satisfies the above-mentioned requirements.

Current implementation of the Kalman filter method for reconstruction of primary vertices is added to the TPC primary vertex finder of the STAR experiment within the CBM Phase-0 program. The algorithm will be applied in the STAR during the Beam Energy Scan II (BES-II) program, which requires high operational speed. At the same time, quality of the fitting procedure should stay high. The developed Kalman filter based primary vertex fit will be optimized for working with real data in online mode within the High Level Trigger of STAR.

As a part of the preparation for the BES-II program the development of express quality assurance (xQA) is required. The developed express QA allows to monitor the data production process. The procedure shows that Express production provides high quality of the dE/dx measurement.