HK 16: Heavy-Ion Collisions and QCD Phases III

Time: Tuesday 17:00–18:30 Location: SCH/A216

Group Report HK 16.1 Tue 17:00 SCH/A216

Hyperon and Hypernuclei Production in the High Baryon Density Region — •Yue Hang Leung — Physikalisches Institut, Heidelberg University

Hyperon and hypernuclei have been suggested to be sensitive probes to the medium properties of the nuclear matter created in heavy-ion collisions. Measurements on the properties of hypernuclei can also give constraints to the hyperon-nucleon interaction, which is an essential ingredient in the equation-of-state of high baryon density matter, such as neutron stars. In this presentation, recent results on hyperon and hypernuclei production from intermediate to low energy heavy-ion collisions will be discussed. Future prospects at FAIR, including the ongoing mCBM project, will be discussed.

HK 16.2 Tue 17:30 SCH/A216

Pining down the (anti-)hypertriton production with ALICE at the LHC — •Michael Hartung for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität, Frankfurt, Germany

At the Large Hadron Collider at CERN, copious production of light (anti-)hypernuclei has been measured in Pb–Pb collisions by the ALICE collaboration. The production of such (anti-)hypernuclei has recently become a topic of high interest, in particular since the properties of these objects are not measured to high precision.
The most prominent example is the (anti-)hypertriton, which is a bound state of a proton, a neutron and a Λ hyperon. It is often discussed as a bound state of a deuteron and a Λ hyperon. If one uses the known Λ separation energy of the hypertriton (about 130 keV) one can estimate a size of about 10 fm of the state, which would be larger as a lead nucleus. The size has consequences for its probability to be formed in a coalescence process, which is not expected from a statistical-thermal model approach.
The (anti-)hypertriton is reconstructed by its decay products, e.g. in the case for the charged two-body decay channel of the hypertriton: ${}^{3}_{\Lambda}\mathrm{H} \rightarrow {}^{3}\mathrm{He} + \pi^{-}$.
We will show the latest measurement of the (anti-)hypertriton production in different collision systems and a comparison to different production models. Furthermore, we will present a novel technique for the determination of the object size of the (anti-)hypertriton.

HK 16.3 Tue 17:45 SCH/A216

Investigation of mass $A = 4$ (anti-)hypernuclei production at the LHC — •Janik Ditzel for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität, Frankfurt, Germany

At the Large Hadron Collider at CERN, light (anti-)hypernuclei are produced abundantly in Pb–Pb collisions. The production of such (anti-)hypernuclei has recently become a topic of high interest, connecting for instance to the possible strangeness content in neutron stars.
The most prominent example is the (anti-)hypertriton, which is a bound state of a proton, a neutron and a Λ hyperon and the main (anti-)hypernucleus to study at the LHC.
Nevertheless, there are heavier hypernuclei which production yields are suppressed with respect to the (anti-)hypertriton. However, they could give further insights into the formation mechanism and the nature of the Y-N or Y-Y interaction. Recent measurements revealed excited states for two mass $A = 4$ (anti-)hypernuclei which make their measurement become feasible. These (anti-)hypernuclei decay weakly after a few centimeters into two or more daughter particles and are reconstructed by their decay products. With the excellent performance of the ALICE apparatus, a clear particle identification of the daughters and a precise reconstruction of the decay vertex is possible.
We will present new results on the measurement of (anti-)hypernuclei within the $A = 4$ mass region, namely the hyperhydrogen-4 and the hyperhelium-4. Furthermore, first insights into the measurement of double-strange (anti-)hypernuclei will be shown.

HK 16.4 Tue 18:00 SCH/A216

Hypernuclei studies in heavy-ion collisions at CBM — •Susanne Glässel and Christoph Blume — IKF Frankfurt

Under the extreme conditions of relativistic heavy-ion-collisions the creation of exotic matter like hypernuclei is possible. Hypernuclei measurements provide insights into the equation-of-state of hadronic matter at high net-baryon densities, as well as into hyperon-nucleon and hyperon-hyperon-interactions. The Compressed Baryonic Matter (CBM) experiment at the future Facility for Anti-Proton and Ion Research (FAIR) in Darmstadt offers the perfect conditions to explore the production of hypernuclei. At beam energies of around 12A GeV, in combination with high interaction rates of up to 10 MHz, an exceptionally high amount of hypernuclei will be created, and even very rare double hypernuclei like ${}^{6}_{\Lambda\Lambda}\mathrm{He}$ are expected. The reconstruction of hypernuclei was implemented into the CBM software PFSimple and optimized with respect to important performance indicators. Expected efficiencies and signal-to-background-ratios were calculated for a reliable estimation of the number of reconstructable hypernuclei; the detector areas with the best performance were identified. Systematical uncertainties were estimated based on simulations from different transport models, like e.g. the novel PHQMD approach, as well as on the signal extrapolation to the full rapidity and transverse momentum range. The experimental sensitivity to properties of hypernuclei, such as their lifetime, was evaluated. Results for ${}^{3}_{\Lambda}\mathrm{H}$ will be discussed as an example. DFG-grant BL 982/3-1, DFG-grant BR 4000/7-1.

HK 16.5 Tue 18:15 SCH/A216

Status of the CBM Micro Vertex Detector Simulations* — •Julio Andary for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt am Main — Helmholtz Forschungsakademie Hessen für FAIR

CBM's Micro Vertex Detector (MVD) will help identify rare particles emitted in violent heavy ion collisions at FAIR and supplements the main tracker (STS) with high-precision pointing capability close to the target. This places, besides outstanding radiation hardness, high demands on the material budget of the sensor which in turn has an impact on the performance of the detector. Thus, the detector has to be optimized w.r.t.multiple scattering and adding unwanted background tracks originating from external conversion of photons.

In order to optimize the detector geometry, CBMRoot simulation data are converted into a data format called AnalysisTree, which provides more user-friendly access to all physical quantities of the particles generated in the experiment. Before analyzing the performance of the MVD, it is necessary to clarify how the reconstruction and mapping in AnalysisTree is implemented, i.e. the criteria according to which AnalysisTree assigns Monte-Carlo particles to reconstructed tracks. The focus in this study is on the gain in tracking performance by the MVD, also considering alternative detector geometries.

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