HK 41: Schwerionenkollisionen und QCD Phasen IV

Zeit: Donnerstag 14:00–16:00 Raum: HG I

Gruppenbericht HK 41.1 Do 14:00 HG I

Exploring QCD matter at highest baryonic densities with CBM — •Tetyana Galatyuk for the CBM-Collaboration — Goethe-Universität, Frankfurt, Germany

The Compressed Baryonic Matter (CBM) experiment has the potential to discover the most prominent landmarks of the QCD phase diagram expected to exist at high net baryon densities. The measurement of rare diagnostic probes offers the possibility to find signatures of exotic phases, and to discover the conjectured first order deconfinement phase transition and its critical endpoint. Effective models, guided by LQCD, expect that the spontaneously broken chiral symmetry should be almost recovered in the region of the phase diagram to be explored by CBM. Phase transitions occur above a critical energy density and can only be observed if the matter extends over a certain volume. Therefore, a key feature of the CBM experimental program is the comprehensive set of observables which will be measured in proton-proton, proton-nucleus, and nucleus-nucleus collisions over the full FAIR energy range. Particular emphasis is put on rare probes which are not accessible by other experiments in this energy range.

The CBM physics requires the development of fast and radiation hard detectors, free-streaming read-out electronics, real-time event reconstruction techniques, and a high-speed data acquisition system. The detector concept is sufficiently flexible to be optimized for the most promising observables. Progress in spectrometer optimization by realistic feasibility studies, and in the development of its detector systems will be discussed.

HK 41.2 Do 14:30 HG I

Parallel approach to online event reconstruction in the CBM experiment — •Ivan Kisel for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

Future many-core CPU and GPU architectures require relevant changes in the traditional approach to data analysis. Massive hardware parallelism at the levels of cores, threads and vectors has to be adequately reflected in mathematical, numerical and programming optimization of the algorithms used for event reconstruction and analysis.

An investigation of the Kalman filter, which is the core of the reconstruction algorithms in modern HEP experiments, has demonstrated a potential several orders of magnitude increase of the speed of the algorithms, if properly optimized and parallelized.

In the CBM experiment at FAIR/GSI all basic reconstruction algorithms have been parallelized. For maximum performance all algorithms use variables in single precision only. In addition, a significant speed-up is provided by localizing data in a high-speed cache memory. Portability of the parallel reconstruction algorithms with respect to different CPU and GPU architectures is supported by the special headers and vector classes, which have been developed for using SIMD instruction sets.

Different reconstruction methods, implemented in CBM, show different degrees of intrinsic parallelism, thus the speed-up varies up to few orders of magnitude. The speed-up factors for each stage of the algorithms parallelization are presented and discussed.

HK 41.3 Do 14:45 HG I

Muon detection in the CBM experiment at FAIR — Claudia Höhne[1], Ivan Kisel[1], Anna Kiseleva[1], •Andrey Lebedev[1,2], and Gennady Ososkov[2] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Laboratory of Information Technologies, Joint Institute for Nuclear Research, Dubna, Russia

The Compressed Baryonic Matter (CBM) experiment at the future FAIR accelerator at Darmstadt is being designed for a comprehensive measurement of hadron and lepton production in heavy-ion collisions from 8÷35 AGeV beam energy, producing events with large track multiplicity and high hit density. The CBM muon detection system is designed to measure muon pairs from the decay of vector mesons (ρ, ω, ϕ, J/ψ). The experimental challenge for muon measurements in heavy-ion collisions at FAIR energies is to identify low momentum muons in an environment of high particle densities. The CBM concept is to track the particles through a hadron absorber system and to perform a momentum dependent muon identification. This concept is realized by segmenting the hadron absorber in several layers and placing triplets of tracking detector planes in the gaps between the absorber layers. The track finding algorithm is based on the track following and the Kalman filter methods, using tracks reconstructed in the STS as initial seeds. The concept for the MUCH detector and the physics performance are presented in this contribution.

HK 41.4 Do 15:00 HG I

Electron identification capabilities of the CBM experiment at FAIR — Claudia Höhne[1], Ivan Kisel[1], •Semen Lebedev[1,2], and Gennady Ososkov[2] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Laboratory of Information Technologies, Joint Institute for Nuclear Research, Dubna, Russia

The Compressed Baryonic Matter (CBM) experiment at the future FAIR facility at Darmstadt will measure dileptons emitted from the hot and dense phase in heavy-ion collisions. In case of an electron measurement, a high purity of identified electrons is required in order to suppress the background. Electron identification in CBM will be performed by a RICH and TRD detectors.

In this contribution, methods which have been developed for the electron identification in CBM will be presented. A fast and efficient RICH ring recognition algorithm based on the Hough Transform has been implemented. An ellipse fitting algorithm has been elaborated because most of the CBM RICH rings have elliptic shapes. An Artificial Neural Network can be used in order to suppress fake rings. The electron identification in RICH is substantially improved by the use of TRD detectors for which several different algorithms for electron identification are implemented. Results of electron identification and pion suppression are presented.

HK 41.5 Do 15:15 HG I

J/Ψ Production in Proton-Nucleus Collisions — •Jan Bsaisou[1] and Nikolai N. Nikolaev[1,2] — [1]Institut für Kernphysik, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany — [2]Landau Institute for Theoretical Physics, 142432 Chernogolovka, Russia

We consider the hard production of the same-side heavy quark-antiquark pairs in proton-nucleus collisions with application to the production of heavy vector mesons. The nonlinear $k_\perp$-factorization technique, which derives from the color dipole approach to small-x QCD, allows to sum all multiple pomeron exchanges and to quantify the effects of the nuclear modification of the gluon densities. Here we report principal results for nuclear effects in the production of heavy quark-antiquark pairs in the color-singlet and color-octet states at large and small transverse momenta. The latter would also contribute to the vector mesons production by color bleacing in final state interaction and hadronization. Based on the QCD-modified AGK unitarity rules for cut pomeron exchanges, we report for both color states the centrality dependence of cross sections.

HK 41.6 Do 15:30 HG I

Feasibility of open charm elliptic flow measurement in CBM — •Selim Seddiki[1,2] and Fouad Rami[2] for the CBM-MVD-Collaboration — [1]Institut für Kernphysik, Goethe Universität, Frankfurt am Main — [2]Institut Pluridisciplinaire Hubert Curien, Strasbourg, France

The Compressed Baryonic Matter experiment (CBM) planned at the Facility for Anti-proton and Ion Research (FAIR) accelerator, aims at studying the high net baryonic density region of the nuclear phase diagram by means of relativistic heavy ion collisions. Open charm particles are considered as one of the main observables, as they constitute penetrating probes of the early, dense phase of the collision. The elliptic flow of open charm is of particular interest, as it is expected to be sensitive to the creation and degree of thermalization of a potential partonic medium produced in the collision.

The measurement of open charm is an experimental challenge at FAIR energies, which are near the charm production threshold. We will present and discuss a feasibility study of the measurement of open charm and its elliptic flow with CBM. It has been found that the measurement of the integrated elliptic flow of open charm may be feasible within one year ($\sim 10^{12}$ minimum bias collisions), with the actual conceptual set-up.

HK 41.7 Do 15:45 HG I

Open charm measurement in the CBM experiment — •Iouri Vassiliev for the CBM-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

One of the major experimental challenges of the CBM experiment is to trigger on the displaced vertex of the Open charm particle decays via hadronic decay modes in the environment of a heavy-ion collision. This task requires fast and efficient track reconstruction algorithms and high resolution secondary vertex determination. Particular difficulties in recognizing the displaced vertex of the rare D-meson and Λ_c decays are caused by weak K_S^0 and Λ decays which produce displaced vertices 1 cm downstream the target, very low multiplicity of the D-meson production, low branching ratios and multiple scattering in the beam pipe and detectors.

The primary and secondary vertices have been reconstructed with high accuracy (5μm and 50μm respectively) from the tracks fitted in the STS with a non-homogeneous magnetic field by the Kalman filter procedure. Two open charm trigger configurations have been proposed: Detached Kaon Trigger and Detached Vertex Trigger. Progress with feasibility studies of the open charm measurements in the CBM experiment will be discussed.