HK 29: Schwerionenkollisionen und QCD Phasen

Zeit: Mittwoch 14:00–16:00 Raum: P 5

Gruppenbericht HK 29.1 Mi 14:00 P 5

CBM-Physik am SIS-100 — •Volker Friese für die CBM-Kollaboration — GSI Darmstadt

Das Ziel des Compressed Baryonic Matter-Experiment (CBM) an FAIR ist die Erforschung des Phasendiagramms stark wechselwirkender Materie im Bereich hoher Nettobaryonendichten. Sein Alleinstellungsmerkmal beruht auf der Fähigkeit, sehr hohe Kollisionsraten zu verarbeiten, die den Zugang zur Messung auch seltener Observablen, wie Hadronen mit Charm-Quarks oder mehrfach seltsame Hyperonen, ermöglichen.

Die Realisierung des vollen CBM-Physikprogrammes erfordert Schwerionenstrahlen vom SIS-300-Synchroton im Endausbau von FAIR. Teile des Programmes werden jedoch schon mit Strahlen aus dem SIS-100 in Angriff genommen werden. Sowohl dieser Beschleuniger als auch das CBM-Experiment sind Bestandteile der FAIR-Startversion. Der SIS-100-Energiebereich (bis zu 11A GeV für schwere Kerne, 14A GeV für leichte Kerne und 29 GeV für Protonen) erlaubt Zugang zu den Fragen nach der Zustandsgleichung komprimierter Kernmaterie, der Eigenschaften von Hadronen im dichten Medium, der Produktion und Propagation von Charm nahe der Produktionsschwelle und der dritten, seltsamen Dimension der Nuklidkarte. In diesem Vortrag diskutieren wir das Physikprogramm und den Aufbau des CBM-Experiments an SIS-100.

HK 29.2 Mi 14:30 P 5

CBM Benchmark Observables — •Iouri Vassiliev for the CBM-Collaboration — Goethe-Universität, Institut für Kernphysik, Frankfurt am Main, 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 in the environment of a heavy-ion collision. This task requires fast and efficient track reconstruction algorithms and high resolution secondary vertex determination.

Results of feasibility studies of these benchmark observables in the CBM experiment will be presented.

HK 29.3 Mi 14:45 P 5

Electron reconstruction and identification capabilities of the CBM Experiment at FAIR — Andrey Lebedev[1,3], •Semen Lebedev[2,3], Claudia Höhne[2], and Gennady Ososkov[3] for the CBM-Collaboration — [1]Frankfurt University, Germany — [2]Giessen University, Germany — [3]Joint Institute for Nuclear Research, 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 Ring Imaging Cherenkov (RICH) detector and Transition Radiation Detectors (TRD).

In this contribution, algorithms which were developed for the electron reconstruction and identification in RICH and TRD detectors are presented. A fast RICH ring recognition algorithm based on the Hough Transform was implemented. An ellipse fitting algorithm was elaborated because most of the CBM RICH rings have elliptic shapes. An efficient algorithm based on the Artificial Neural Network is implemented for electron identification in RICH. In TRD track reconstruction algorithm which is based on track following and Kalman Filter methods was implemented. Several algorithms for electron identification in TRD were developed and investigated. The best-performed algorithm is based on the special transformation of energy losses measured in TRD and usage of the Boosted Decision Tree as classifier. Results and comparison of different methods are presented.

HK 29.4 Mi 15:00 P 5

Parallel Kalman filter track fitting library for the CBM experiment — •Maksym Zyzak[1,2], Ivan Kisel[3], Igor Kulakov[1,2], and Hans Pabst[4] for the CBM-Collaboration — [1]Goethe-Universität Frankfurt am Main — [2]National Taras Shevchenko University of Kyiv, Ukraine — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Intel GmbH

The CBM experiment at FAIR is being designed to study heavy-ion collisions at extremely high interaction rates. The experiment requires the full on-line event reconstruction, therefore the speed of the algorithms is crucial.

A library for track fitting based on the Kalman filter (KF) has been developed for the CBM experiment. The library includes: track fitting procedures based on the conventional Kalman filter, the square root Kalman filter and the UD Kalman filter; the Kalman filter based smoother; the deterministic annealing filter.

The whole functionality is implemented using 3 approaches: simple headers, which overload SIMD intrinsics; Vc library; Intel ArBB library. The KF library has been tested with icc and gcc compilers on different many-core CPU platforms. The library shows a strong scalability with the number of CPU cores that is both independent of the platform, the compiler as well as independent of the supplied implementations.

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HK 29.5 Mi 15:15 P 5

Application of a Kalman Filter in Track Reconstruction* — •Erik Krebs[1], Jochen Markert[1,2], and Joachim Stroth[1,2] — [1]Goethe-Universität, Frankfurt am Main — [2]GSI Helmholtzzentum für Schwerionenforschung GmbH, Darmstadt

The Kalman filter is a mathematical method to estimate the evolution of linear, dynamical systems and has become an established method for track reconstruction. The Deterministic Annealing Filter is an extension of the Kalman filter that introduces competition between measurements and allows rejection of fake measurements.

An extended Kalman filter that takes multiple scattering and energy loss into account has been implemented for the HADES-experiment. The filter works with position information from reconstructed drift chamber segments and the results have been compared to a global Runge-Kutta track fit. To reduce systematic errors of the segment reconstruction for highly curvilinear tracks the Kalman filter has been revised to work directly with the wire information of the drift chambers. Additionally, track candidates may include measurements from multiple tracks. For these reasons, an extension of the Kalman filter, the Deterministic Annealing Filter, is used to discriminate measurements that do not belong to a track. Measurements are assigned weights and an annealing process is introduced to avoid local optima in measurement assignments.

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HK 29.6 Mi 15:30 P 5

Pattern Recognition for a Continuously Operating GEM-TPC — •Johannes Rauch for the GEM-TPC-Collaboration — Technische Universität München

A pattern recognition software for a continuously operating high rate Time Projection Chamber with Gas Electron Multiplier amplification (GEM-TPC) has been designed and tested. A track-independent clustering algorithm delivers space points. A true 3-dimensional track follower combines them to helical tracks, without constraints on the vertex position. Fast helix fits, based on a conformal mapping on the Riemann sphere, are the basis for deciding whether points belong to one track.

The software has been tested on simulated as well as on real data taken in a physics run of the GEM-TPC prototype installed in the FOPI detector at GSI facility, Germany. To assess the performance of the algorithm in a high-rate environment, $\bar{p}p$-interactions corresponding to a maximum average track density of $0.5\,\mathrm{cm/cm^3}$ have been simulated.

The pattern recognition is capable of finding all kinds of track topologies with high efficiency and provides excellent seed values for fitting or online event selection. Computational costs are $\mathcal{O}(50)$ ms/track on a 3.1 GHz office PC. Parallel implementation of the code on a graphics processing unit (GPU) is under investigation.

Structure, functioning and benchmark results of the algorithm will be presented.

HK 29.7 Mi 15:45 P 5

Standalone FLES Package for Event Reconstruction and Selection in CBM — Ivan Kisel[1], •Igor Kulakov[2,3], and Maksym Zyzak[2,3] for the CBM-Collaboration — [1]GSI Helmholtzzentrum fur Schwerionenforschung GmbH — [2]Goethe-Universitat Frankfurt am Main — [3]National Taras Shevchenko University of Kyiv, Ukraine

The main objective of the CBM experiment at FAIR is the measurement of extremely rare signals, therefore collision rates up to 10 MHz and correspondent First Level Event Selection (FLES) is required. Since there are no simple trigger criteria, a full event reconstruction is needed in FLES.

The FLES package has been initially developed in the CBMROOT simulation and reconstruction framework. A standalone version of the FLES package adds flexibility with respect to different modern and future many-core CPU/GPU architectures. That is important for further development, optimization and testing of the package on various CPU/GPU hardware. The package is parallelized both at the data (using the SIMD instruction set) and the task (using the Threading Building Blocks library) levels.

Extensive tests with simulated Au-Au collisions at 25 GeV have been performed. The reconstruction efficiencies for tracks and short-lived particles are presented and discussed. The FLES package shows a strong scalability on various many-core systems.

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