HK 44: Instrumentation IX

Zeit: Mittwoch 16:30–18:30 Raum: HS 11

Gruppenbericht HK 44.1 Mi 16:30 HS 11

The Silicon Tracking System of the CBM Experiment at FAIR — •Ievgeniia Momot for the CBM-Collaboration — Goethe-Universität, Frankfurt — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — KINR, Kyiv, Ukraine

The Compressed Baryonic Matter (CBM) experiment at FAIR is designed to study dense nuclear matter in the laboratory with help of heavy nuclei up to kinetic energies of 11AGeV.

One of the detector systems in this experiment is the Silicon Tracking System (STS). Its task is to measure the trajectories of up to 800 charged particles per nuclear collision at interaction rates up to 10MHz. In order to guarantee the required performance over the full lifetime of the experiment, the detector system has to have a low material budget, a high granularity, a high signal-to-noise (SNR) ratio, and a high radiation tolerance. As a result of optimisation studies, the STS consists of double-sided silicon microstrip sensors, which have to provide readout with SNR>10, even after irradiation with the expected lifetime fluence of 10^{14}n/cm^2 1MeV equivalent.

The STS will be located in the gap of a superconducting dipole magnet comprising 8 tracking stations, which consist of 896 modules mounted on 106 ladders. The readout features self-triggering front-end electronics that streams data to a computing farm for online analysis.

Recent progress with detector design, component development towards start of series production, and the mSTS detector demonstrator during the mCBM campaign at GSI's SIS18 accelerator will be covered in this talk.

HK 44.2 Mi 17:00 HS 11

Online tracking with the ALICE Transition Radiation Detector — •Marten Ole Schmidt for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

After the ongoing maintenance work at the LHC, the ALICE detectors will collect data in a continuous readout mode instead of the triggered mode used before. Major upgrades are conducted on most of the subdetectors to allow for this new readout scheme.

The Transition Radiation Detector (TRD) will keep its current design and only update its readout chain. Up to now, both digits from hits in the TRD as well as on-the-fly reconstructed TRD tracklets were stored on tape. The digits were used for the offline performed tracking, while the tracklets were used to generate online trigger decisions. Due to bandwidth constraints, the TRD read out after the upgrade is restricted to tracklets, such that the tracking implementation must change.

Tracks reconstructed in the inner detectors of ALICE will be prolonged to the TRD and used as seeds. The new TRD tracking was developed and tested in the ALICE High Level Trigger during data taking in 2018 both in p–p and Pb–Pb collisions. We present the performance of the new tracking algorithm in both collision systems and discuss the status of the implementation on GPUs which is foreseen for the new Online-Offline computing framework of ALICE for the next data taking periods.

HK 44.3 Mi 17:15 HS 11

Development of cooling demonstrator for the CBM Silicon Tracking System — •Kshitij Agarwal for the CBM-Collaboration — Physikalisches Institut - Eberhard Karls Universität Tübingen, Tübingen, Germany

As the core detector of the CBM experiment, the Silicon Tracking System (STS) located in the dipole magnet provides track reconstruction & momentum determination of charged particles from beam-target interactions.

Due to the expected irradiation damage (fluence - 10^{14} n_{eq}(1MeV)/cm^2), the silicon microstrip sensors will dissipate $<$ 6 mW/cm^2 at -10°C. Thus it is imperative to keep the sensors at or below -10°C at all times to avoid thermal runaway and reverse annealing by forced N_2 cooling. The corresponding electronics connected via microcables are placed outside detector acceptance and bi-phase CO_2 cooling will be used to remove $\sim$ 40kW power dissipated.

To experimentally verify the aforementioned concepts under realistic mechanical constraints, a thermal demonstrator comprising a half-layer of STS is under development. This contribution will describe the recent R&D on several subcomponents, such as CO_2 cooling plant and corresponding distribution system, optimised CO_2 heat exchanger plates, dummy silicon heaters, thermal enclosure, etc. In addition, future plans on the demonstrator integration and design will be also presented.

This work is supported by GSI/FAIR.

HK 44.4 Mi 17:30 HS 11

A PANDA Track Finding Algorithm based on the Apollonius Problem — •Anna Scholl, Tobias Stockmanns, and James Ritman for the PANDA-Collaboration — Forschungszentrum Jülich GmbH, IKP1, Jülich

One of the main components of the PANDA experiment is the Straw Tube Tracker (STT). It consists of over 4200 gas-filled drift tubes. When a charged particle ionizes the gas in one of the drift tubes, the electrons drift to the anode, which is located in the center of each tube. Since only the drift time of the electrons to the anode is known, as well as the position of the anode wire, only the radius around the anode where the ionization must have taken place can be calculated. This results in a circle (isochrone) around the center of the tube. The track of the charged particle must pass tangentially to the isochrone.

Algorithms based on two or three dimensional hitpoints, usually do not use the additional isochrone information. For the STT, however, a tracking algorithm is needed that finds tracks that are tangential to every isochrone. To deal with this challenge, this work presents an approach based on the Apollonius problem. The Apollonius problem is a mathematical problem of connecting three circles with a fourth circle that is tangential to the other three circles. This mathematical description is the basis for a Hough transformation to find the track of the charged particle. In this presentation first results of the algorithm described above will be presented.

HK 44.5 Mi 17:45 HS 11

Using neural networks for event reconstuction at NeuLAND — •E. Hoemann, J. Mayer, P. Scholz, and A. Zilges — University of Cologne, Institute for Nuclear Physics

In various fields of modern data processing, neural networks play a key role. Popular applications like speech and face recognition are already part of our everyday lives. Where can we apply them in science for similar questions?

For the New Large Area Neutron Detector NeuLAND[1] we come across two classification problems: How many neutrons have interacted in the detector and which clusters are created through primary interactions? Humans need to reduce the data set to special quantities to gain information, but some underlying correlations could be missed in this process. In contrast, a neural network can use the whole data set, complex structures, and optimization algorithms to profit from these correlations.

The talk will address different approaches to construct a neural network for the mentioned classification problems and its performance in comparison to the conventional methods.

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[1]Technical Report for the Design, Construction and Commissioning of NeuLAND, available at https://edms.cern.ch/document/1865739/1

HK 44.6 Mi 18:00 HS 11

Particle-Track Reconstruction with Artificial Neural Networks — Lukas Bierwirth, Laura Fabbietti, Martin Jan Losekamm, Stephan Paul, and •Thomas Pöschl — Technische Universität München

Finding the parameters of a particle's track in a detector in real time is a resource-intensive pattern recognition task. Artificial neural networks are a promising approach to this problem because of their ability to self-learn complex features from training data while still achieving a short reconstruction time per event.

We develop a neural network to analyze the data of the RadMap Telescope, which will measure the radiation environment aboard the International Space Station. We compare the performance of the neural network to a classical algorithm based on the Hough transform using simulated data and measurements from a test campaign at Paul Scherrer Institute.

HK 44.7 Mi 18:15 HS 11

Particle-Antiparticle Discrimination Using Neural Networks

— Laura Fabbietti, Martin J. Losekamm, •Jan Henrik Müller, Stephan Paul, and Thomas Pöschl — Technische Universität München

Cosmic-ray antiproton measurements are challenging because of the small flux of antiprotons in comparison to the large background flux of ordinary ions, requiring an effective particle-identification algorithm. A classical approach is to fully reconstruct the event topology to draw conclusions about the incoming particle's species. However, for space-based experiments, this can be impracticable since the available computing power and calculation time are not sufficient to allow such complex calculations. An alternative approach is the use of neural networks: They can be trained on high-power computers on ground and then implemented on the detector's front-end electronics to provide fast reconstruction with small computational effort. In this work, we assess different types of neural networks for identifying antiprotons, protons, and heavy ions in the Multi-Purpose Active-Target Particle Telescope and evaluate their performance with simulated detector data. We analyze the result, focusing on events that were wrongly classified. This is necessary because the signal-to-background ratio of antiprotons is in the order of 10^{-4} and rare misclassifications have a large impact on the flux measurement. We also discuss possibilities to increase the network's reconstruction ability for rare events.