HK 28: Computing I

Time: Tuesday 16:00–17:45 Location: HK-H5

Group Report HK 28.1 Tue 16:00 HK-H5
Track Finding with PANDA — •Anna Alicke[1], Tobias Stockmanns[1], and James Ritman[2,1,3] for the PANDA-Collaboration — [1]Forschungszentrum Jülich, Institut für Kernphysik — [2]GSI Helmholtzzentrum für Schwerionenforschung — [3]Ruhr-Universität Bochum, Experimentalphysik, Lehrstuhl I

An overview of the various track finding methods for the barrel part of the PANDA detector will be presented. PANDA's barrel tracking system consists of three detector parts. The innermost tracking detector is the Micro-Vertex-Detector (MVD). Surrounding the MVD is the the Straw Tube Tracker (STT), which consists of over 4200 drift tubes. Additionally, forward boosted tracks are identified by the Gas Electron Multiplier plates (GEM). The STT tubes produce coarse track information given by their tube ID and a drift time information which significantly improves the spatial resolution. The drift time information determines circles (isochrones) to which the tracks must pass tangentially.

Track finding is divided into two parts: track finding for primary particles and for secondary particles. Two algorithms for each part are presented and compared. The two algorithms for primary particles are global tracking algorithms. The first algorithm is the current default track finder in PANDA and is based on adding hits to existing track assumptions. The second one is a track finder based on Hough transformations. For secondary particles a well optimized track finder based on a cellular automaton is compared to a novel approach that uses three chosen hits to find the true particle track.

HK 28.2 Tue 16:30 HK-H5
Machine Learning Approach for Track Finding Using Language Models — •Jakapat Kannika, James Ritman, and Tobias Stockmanns — Forschungszentrum Jülich, Jülich, Germany

In the particle physics experiments, track finding is a pattern recognition task in which input hits are clustered into different groups of output tracks. The hits are signals of the particles traveling through the detectors, and the tracks are groups of trajectories of those particles. This study is focusing on implementing a track finding algorithm using language models for straw tube based tracking systems. The language model is a probability distribution which is used in order to recognize the sequences of data. The model is widely used in the field of natural language processing, where applications such as speech recognition, handwriting recognition, word prediction also use the language models. In the current study, we extract features from the hit data and treat them as discrete values similarly to words, then do a language modeling. The obtained language model is used in the same way as in the word prediction applications, but in this case, it predicts the next hits. The algorithm is now able to track particles in square and hexagonal geometries in conditions where noise or crossing tracks are presented. The current status and an outlook on the overall performance will be presented.

HK 28.3 Tue 16:45 HK-H5
Space-charge distortions in the ALICE TPC I: A data-driven approach to model space-charge distortion fluctuations — •Matthias Kleiner — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) is the main tracking and particle identification detector of the ALICE experiment at the CERN LHC. For Run 3, starting in 2022, interaction rates of 50 kHz in Pb-Pb collisions required a major upgrade of the TPC readout system. The Multi-Wire Proportional Chambers (MWPCs) were replaced by stacks of four Gas Electron Multiplier (GEM) foils, allowing continuous data acquisition. Due to intrinsic properties of the GEMs, a significant amount of ions produced during the electron amplification drifts into the active volume of the TPC, leading to space-charge distortions of the nominal drift field. Various effects cause fluctuations of the space-charge distortions on very short time scales. These fluctuations have to be corrected to preserve the intrinsic tracking precision of the TPC of 100 μm. A dedicated calibration procedure has been developed for the correction of the space-charge distortions. The measured integrated digital currents (IDCs) on the pads, which are used as an estimate for the space-charge density, are processed and taken as an input for a data-driven machine learning approach.

In this talk, procedures for the optimization of the IDCs for the space-charge distortion calibration for the ALICE TPC in Run 3 will be presented.

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HK 28.4 Tue 17:00 HK-H5
Space-charge distortions in the ALICE TPC II: Data-driven machine learning algorithms for the space-charge distortion calibration — •Ernst Hellbär[1], Harald Appelshäuser[2], Marian Ivanov[1], Matthias Kleiner[2], Silvia Masciocchi[1], and Jens Wiechula[2] for the ALICE-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Institut für Kernphysik, Goethe-Universität Frankfurt, Germany

The Time Projection Chamber (TPC) plays a crucial role in tracking and particle identification for the ALICE experiment at the CERN LHC. The readout of the TPC was upgraded during the long shutdown 2 of the LHC in order to provide the capability to continuously record collision data at 50 kHz of Pb-Pb collisions. The intrinsic properties of the new readout chambers based on Gas Electron Multiplier (GEM) technology lead to a backflow of amplification ions into the drift volume of the TPC which is minimized to below 1 %. In combination with the expected particle multiplicities and high interaction rates in Pb-Pb collisions, the ion backflow (IBF) causes significant space-charge distortions and distortion fluctuations. The latter are relevant on time scales of the order of 10 ms and have to be fully corrected accordingly to restore the intrinsic space-point resolution of the TPC of the order of a few 100 μm. The calibration of the distortion fluctuations is performed using data-driven machine learning algorithms which are trained with simulated data. The calibration procedure and first result of the performance will be presented.
This contribution is supported by BMBF.

HK 28.5 Tue 17:15 HK-H5
The mSTS as a pathfinder for the Detector Control System of the STS in the CBM experiment — •Marcel Bajdel for the CBM-Collaboration — Goethe-Universität Frankfurt am Main

The Compressed Baryonic Matter (CBM) experiment dedicated to the study of the properties of the strongly interacting matter is now under construction at the Facility for Anti-proton and Ion Research (FAIR) in Darmstadt.

In order to optimize the performance of experimental subsystems, a small-scale mCBM demonstrator was installed for the test purposes. As the future Silicon Tracking System (STS) is the core detection system of CBM, the mSTS is now a subject of the intensive investigation.

The CBM's Detector Control System (DCS) focuses on monitoring of the detector operation conditions, provides tracking of its vital parameters, data storage, and ensures a safe operation of the mSTS. A novel approach based on the containerization was implemented for these purposes. A Experimental Physics and Industrial Control System (EPICS) based system was configured and deployed in order to control, monitor and store process variables (PV) associated with the hardware.

In this presentation, we will present the results from the beam-test campaigns in 2020-2021, which allowed us to evaluate the performance of its soft- and hardware components.

HK 28.6 Tue 17:30 HK-H5
Comparison of simulation frameworks for the $\bar{\text{P}}$ANDA FAIR phase-0 experiment at MAMI — •Alexander Greiner[1], Alaa Dbeyssi[1], David Rodriguez Pineiro[1], Dong Liu[1], Frank Maas[1,2,3], Julian Moik[1], Luigi Capozza[1], Oliver Noll[1], Peter-Bernd Otte[1], Sahra Wolff[1], and Samet Katilmis[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Germany — [2]Institute of Nuclear Physics, Johannes Gutenberg University, Mainz, Germany — [3]PRISMA Clus- ter of Excellence, Mainz, Germany

A complex detector system is being developed for the $\bar{\text{P}}$ANDA experiment at the FAIR accelerator facility in Darmstadt. The electromagnetic process group (EMP) at the Helmholtz institut in Mainz is developing the backward end-cap (BWEC) of this detector and a preliminary version will be used in the $\bar{\text{P}}$ANDA FAIR Phase-0 project to measure the electromagnetic transition form factor of π^0 at the MAMI-accelerator in Mainz. To verify that the planned setup of the BWEC can withstand the radiation exposure of the experiment without affecting the data acquisition through malfunctions, simulations were performed to estimate the radiation exposure of the whole experiment and of single important components. In the context of these simulations a comparison between the used simulation framework GEANT4 and the prominent FLUKA framework was performed.